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(12) **United States Patent**
Sniffin

(10) **Patent No.: US 8,162,895 B2**
(45) **Date of Patent: Apr. 24, 2012**

(54) **ENDOLUMINAL ACCESS DEVICE**

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(73) Assignee: **Tyco Healthcare Group LP**, North Haven, CT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 363 days.

(21) Appl. No.: **12/358,684**

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(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
A61M 5/178 (2006.01)

(52) **U.S. Cl.** **604/167.01**; 604/167.06; 604/170.02

(58) **Field of Classification Search** 604/167.01, 604/167.11, 284, 164.01–164.13, 167.06, 604/170.01–170.02, 171; 600/154, 164, 600/121, 130, 136, 138–139, 143
See application file for complete search history.

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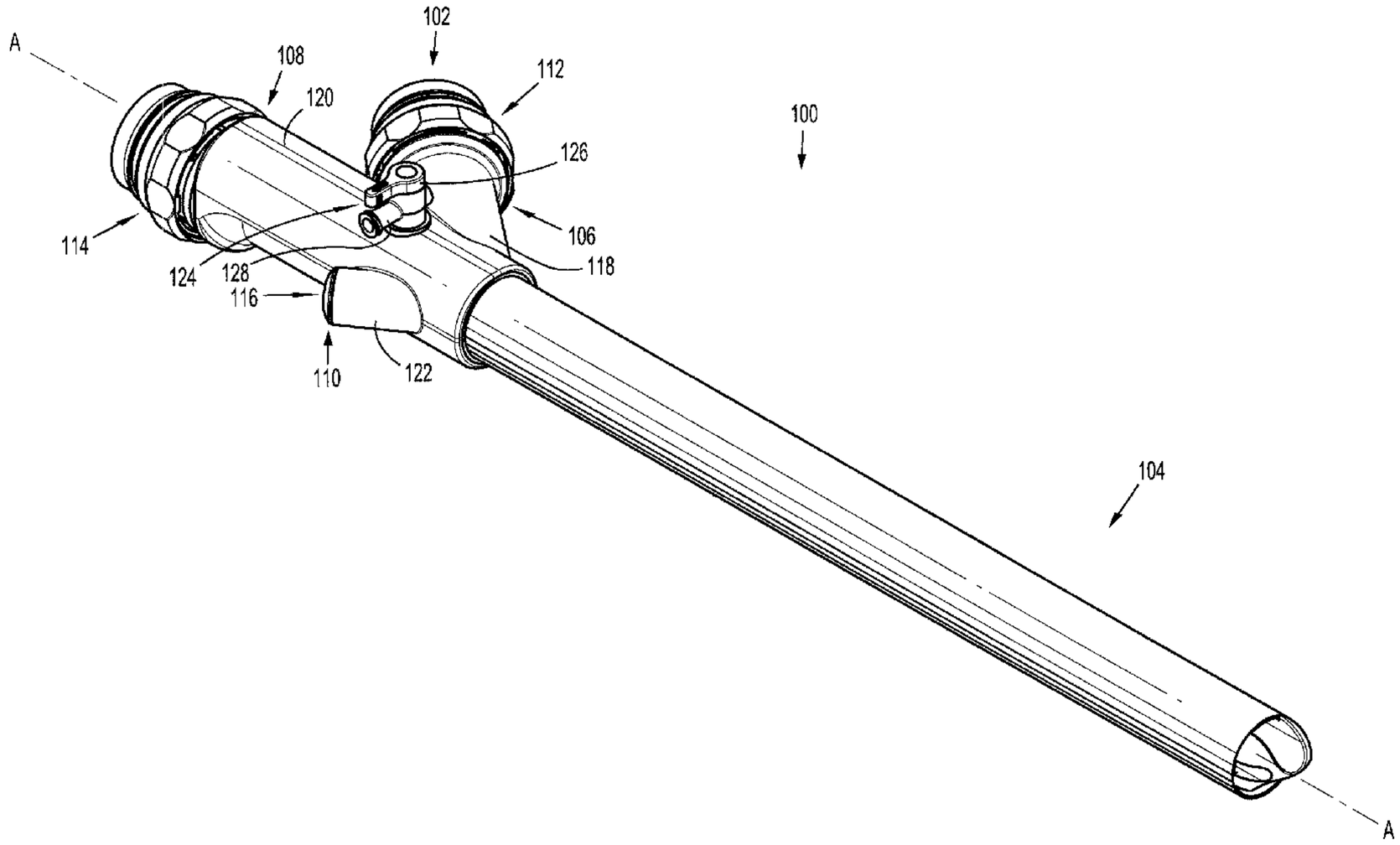
Primary Examiner — Nicholas Lucchesi
Assistant Examiner — Melissa A Snyder

(57) **ABSTRACT**

A surgical access apparatus for providing access inside a body includes a housing having a first port, a tubular member extending distally from the housing and defining a longitudinal axis therealong, wherein the tubular member includes a lumen extending therethrough. a shaft insert disposed in the lumen of the tubular member, wherein the shaft insert forms first, second, and third passageways extending along the lumen of the tubular member, wherein each of the first, second, and third passageways is adapted to receive a surgical instrument; and a first seal assembly covering the first port of the housing and defining a first passage disposed in communication with the first passageway defined by the shaft insert in the tubular member, wherein the first seal assembly is adapted to form a seal around the surgical instrument inserted through the first passage of the first seal assembly.

20 Claims, 17 Drawing Sheets



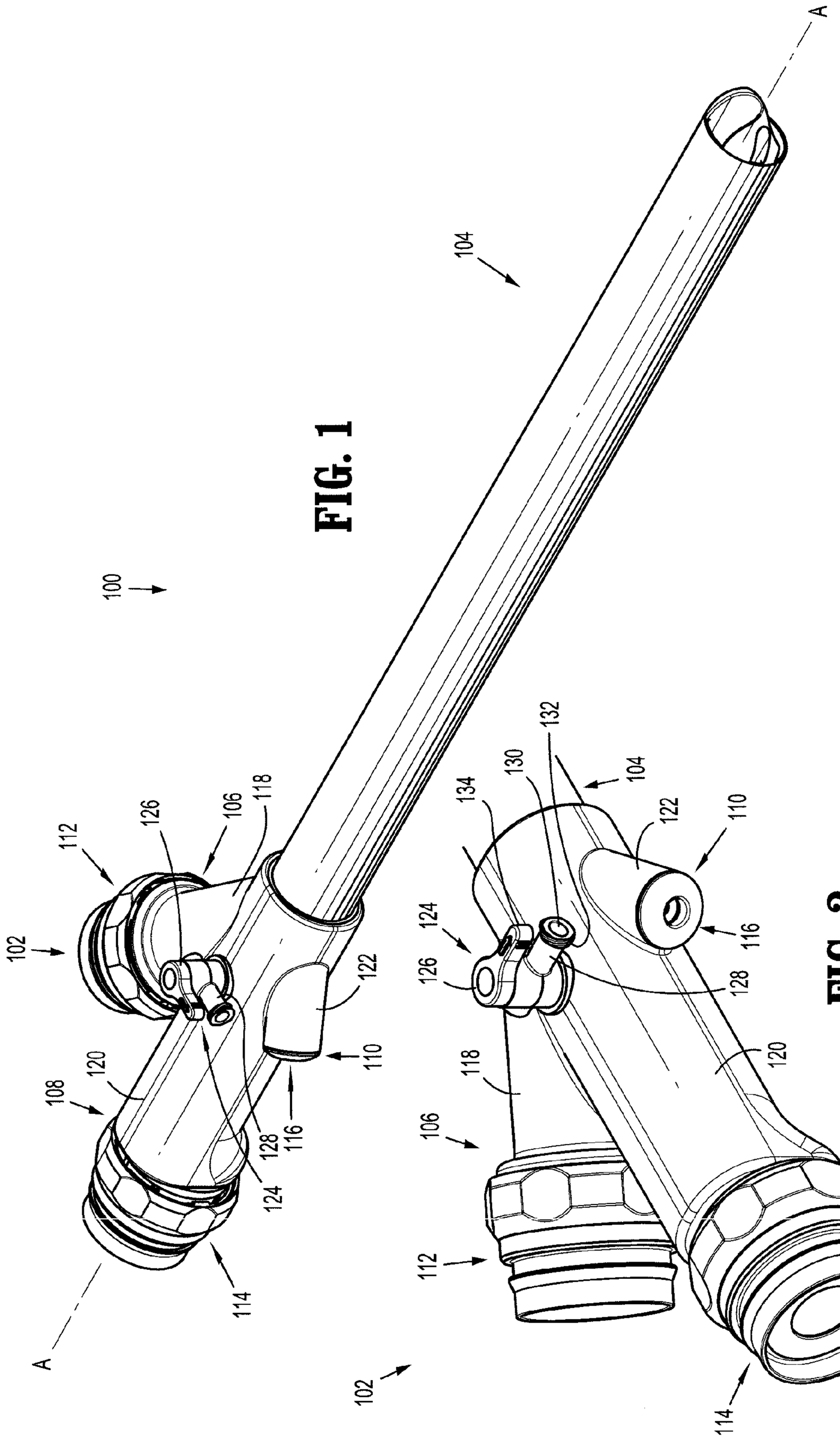

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FIG. 1

FIG. 2

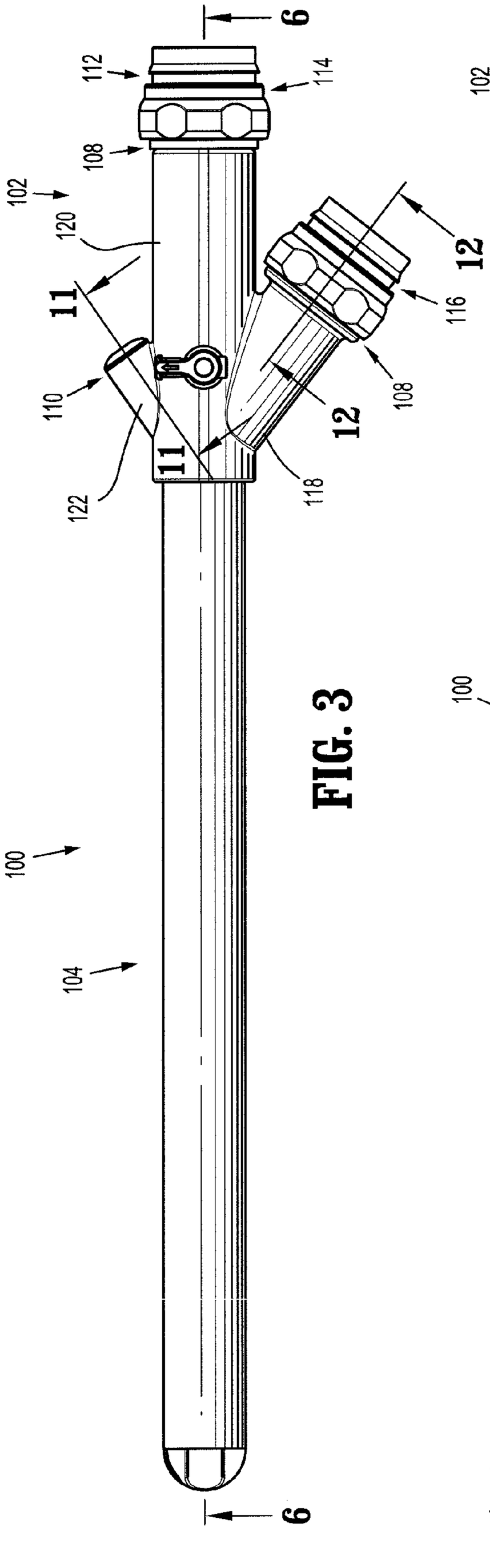
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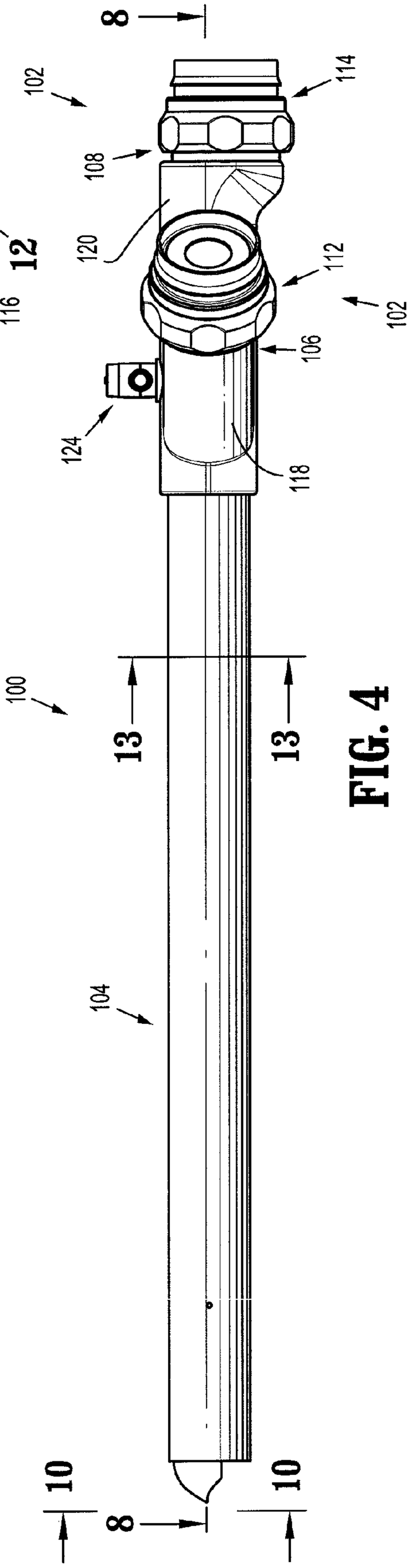
FIG. 3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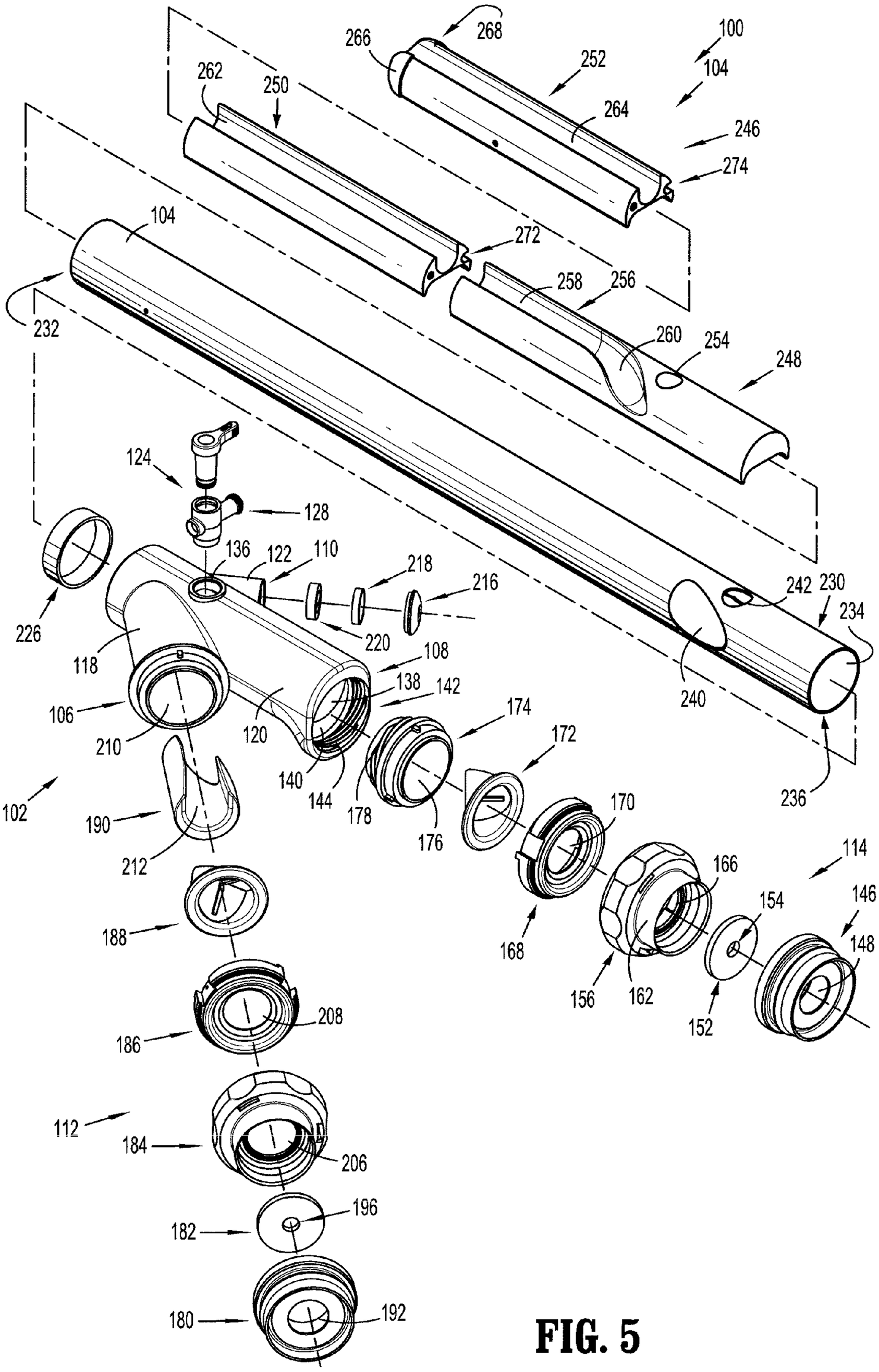
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FIG. 5

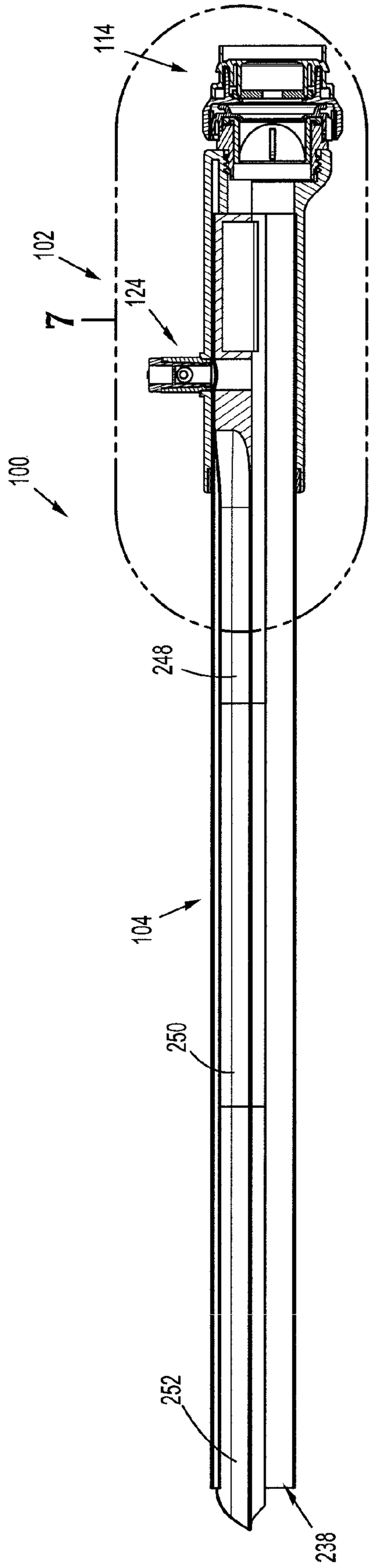
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FIG. 6

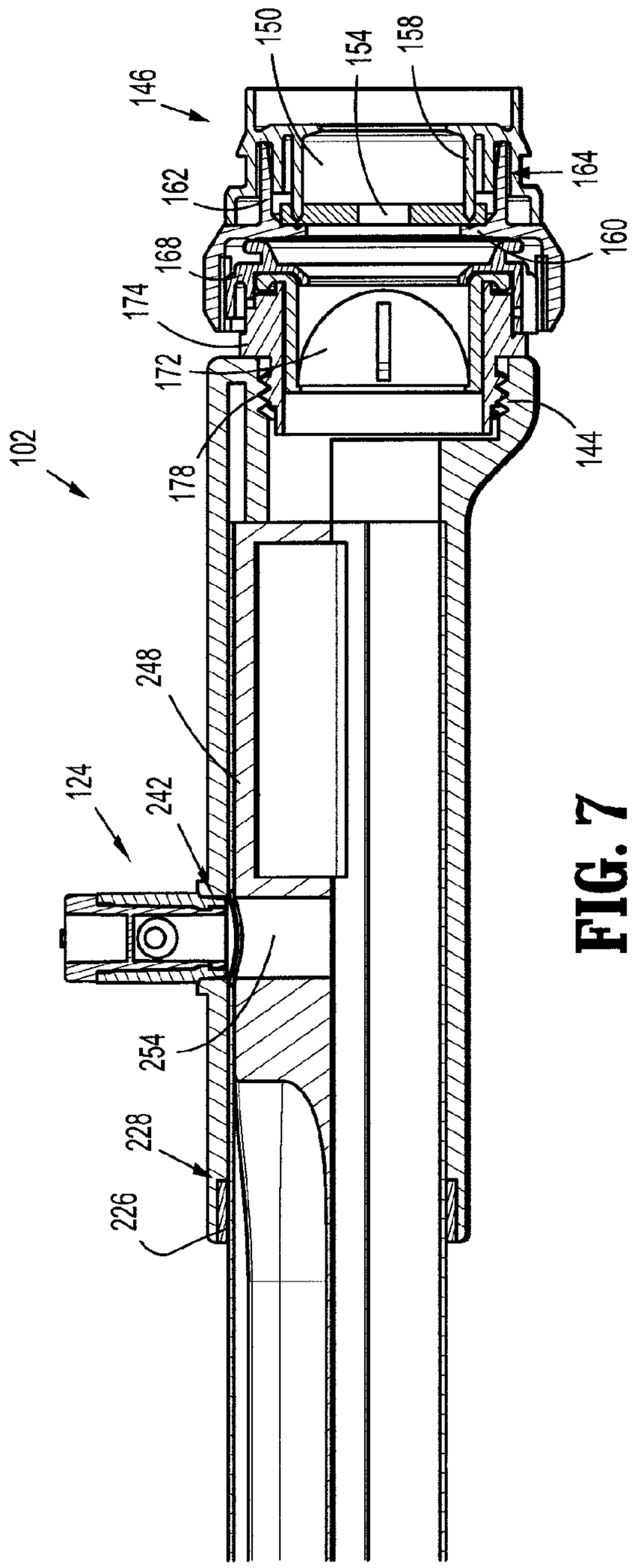
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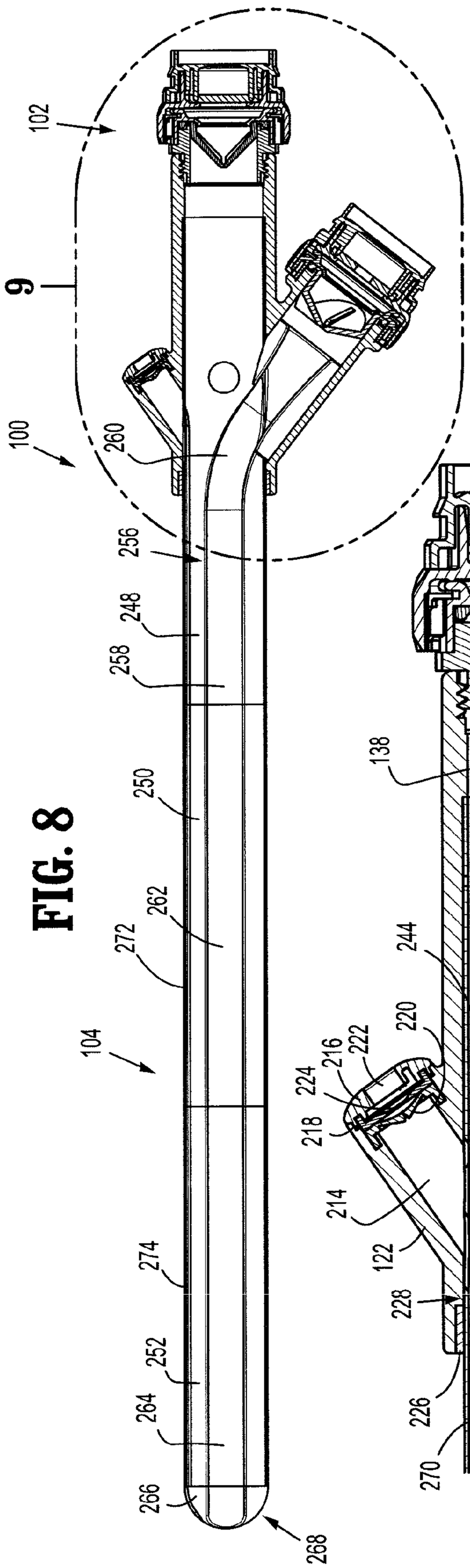
FIG. 7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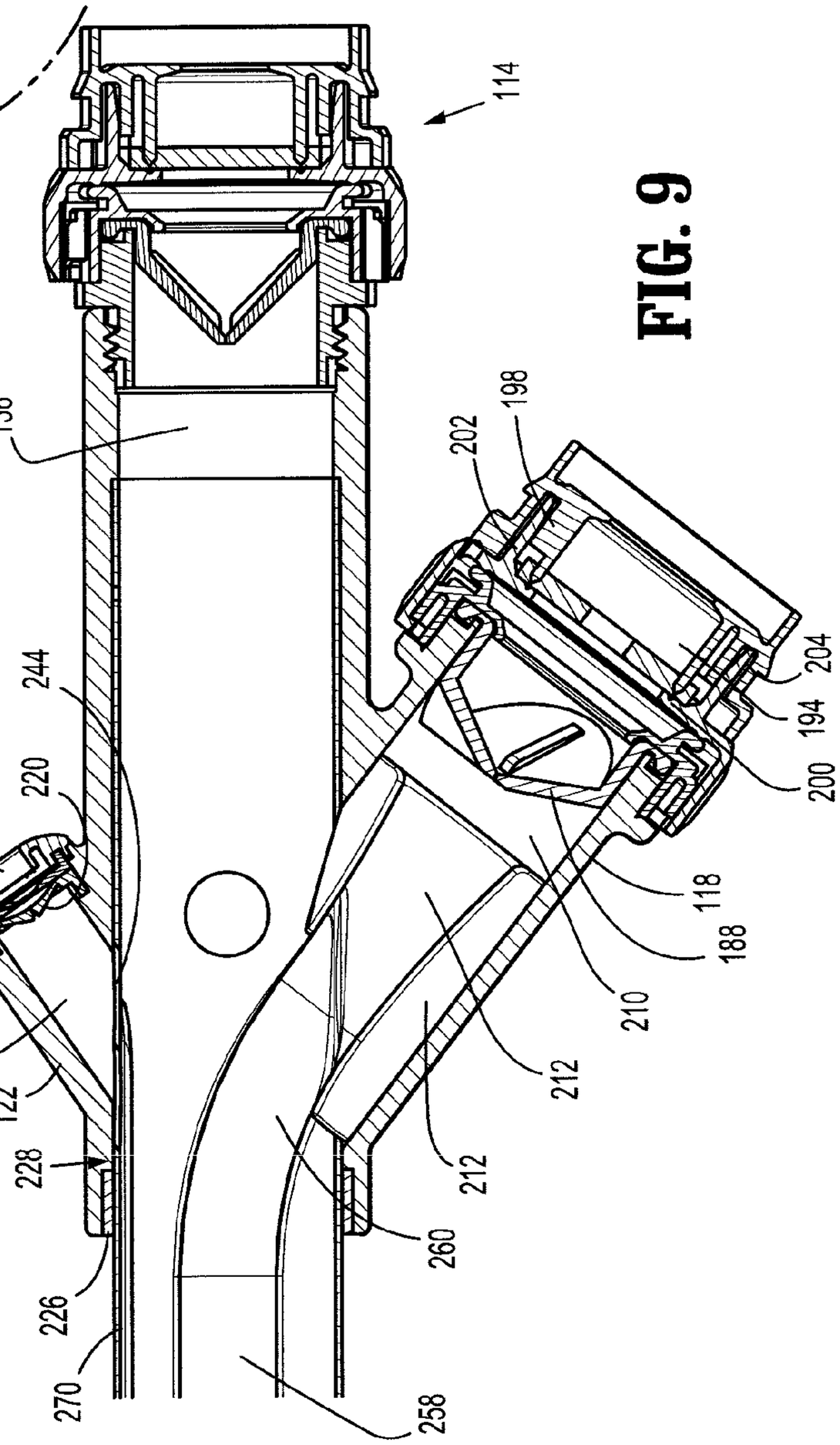
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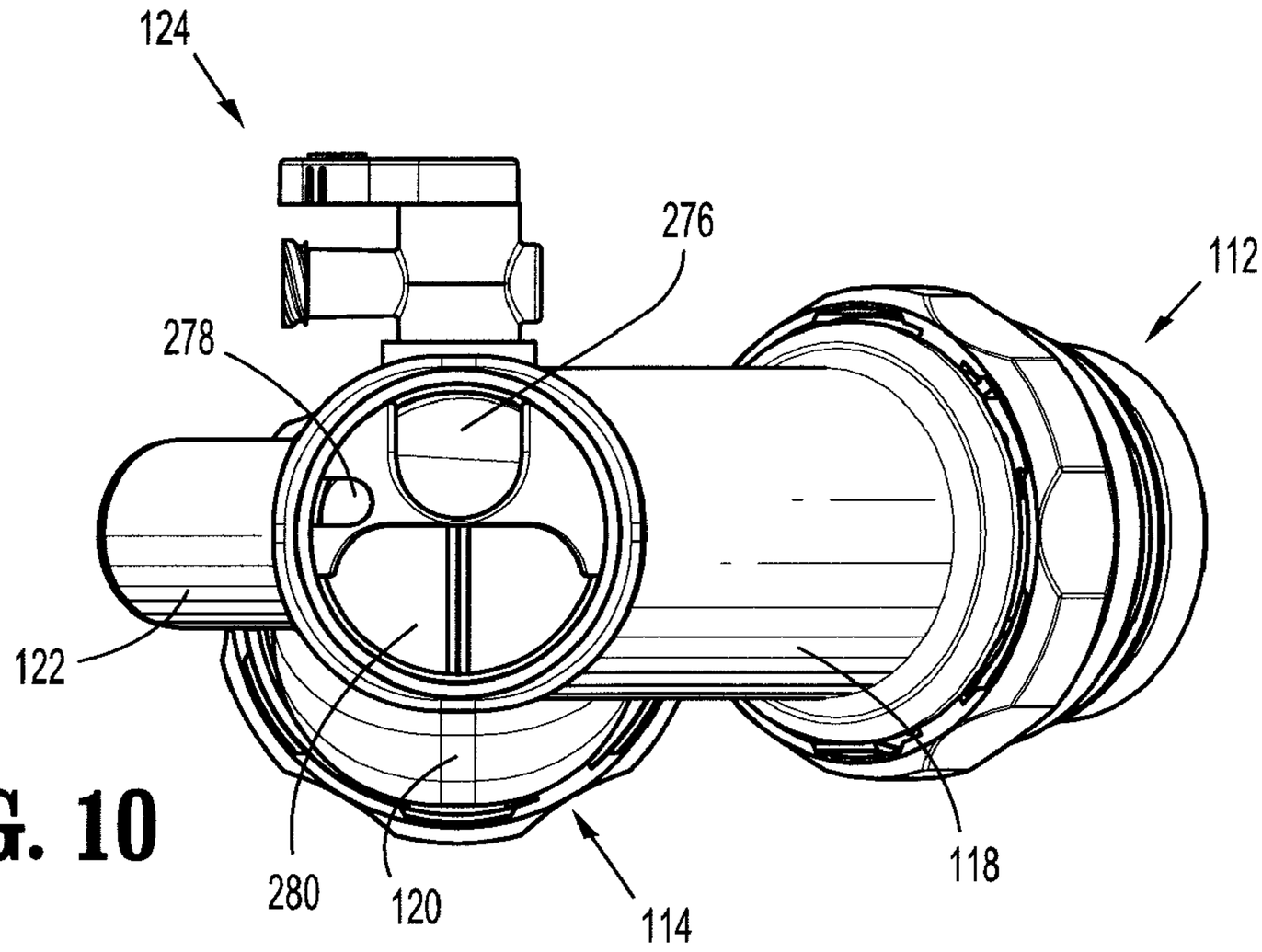
FIG. 9



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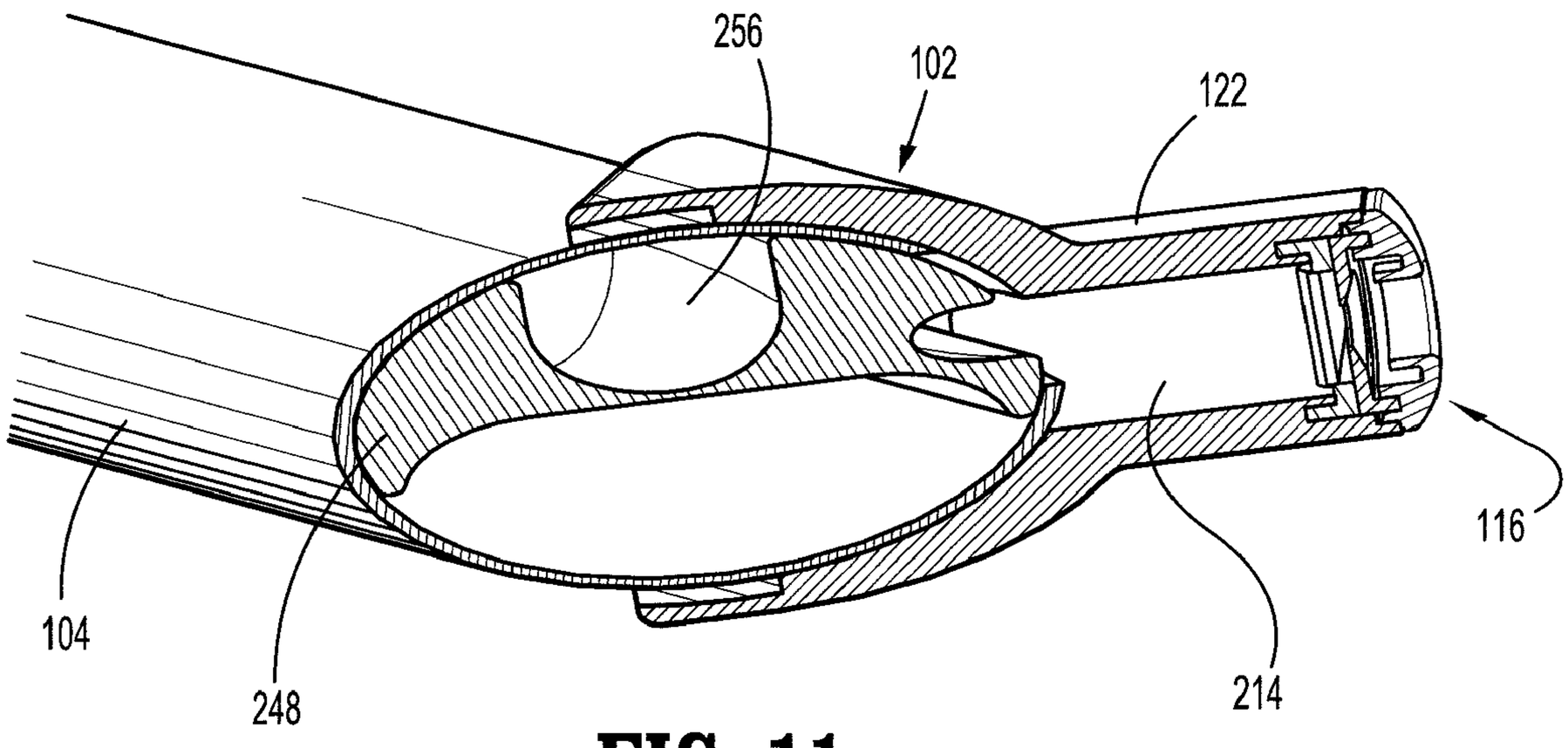

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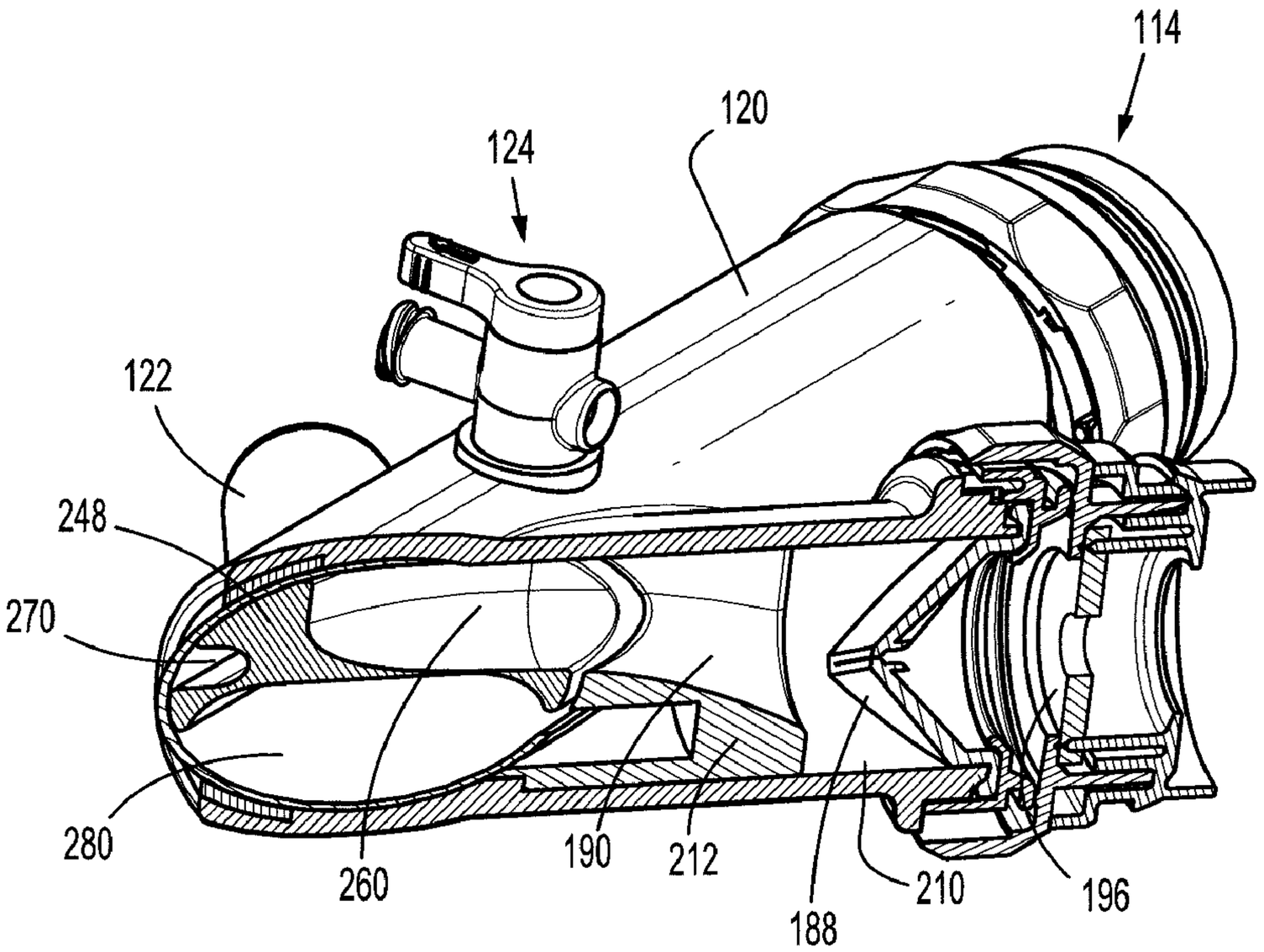
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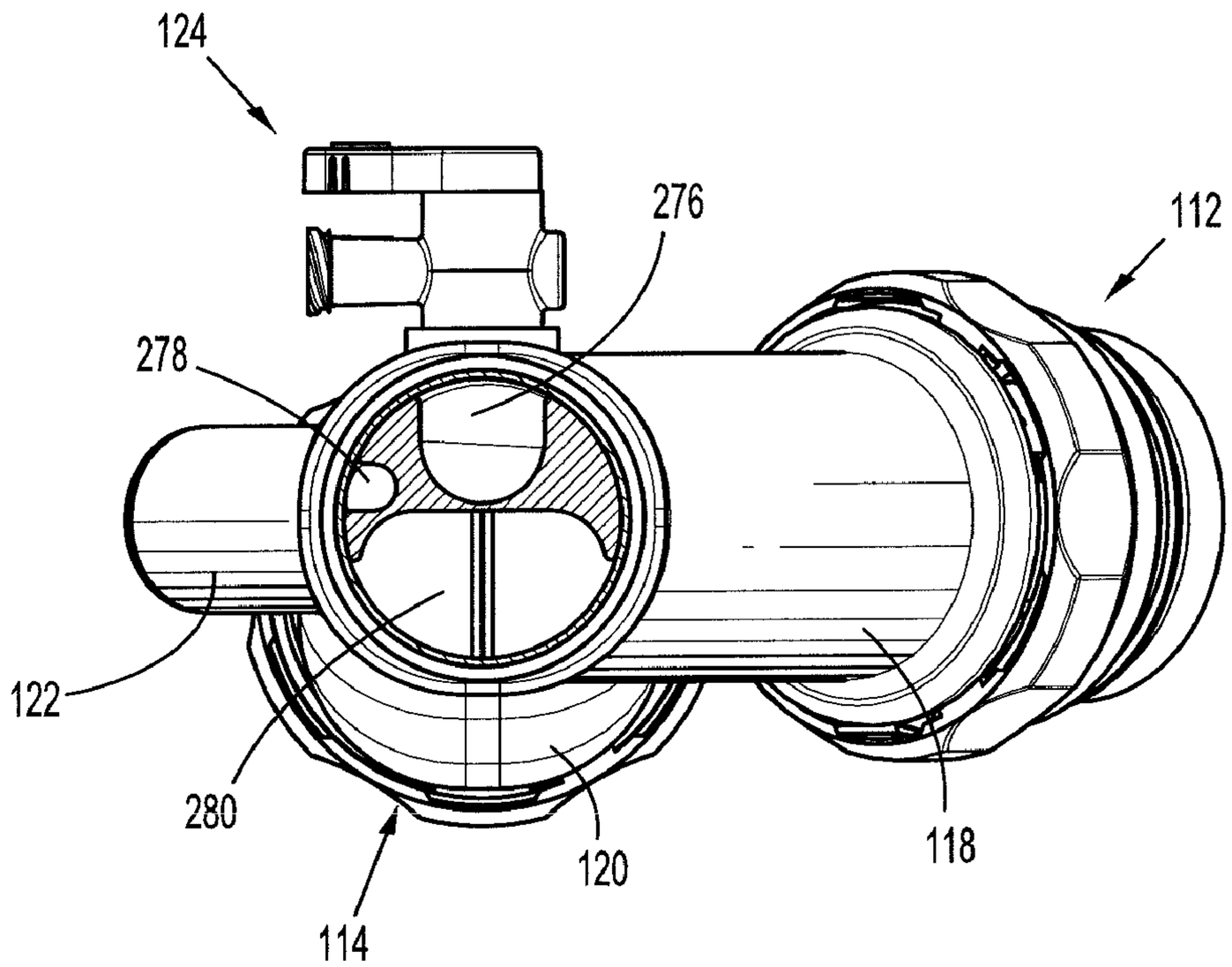
FIG. 12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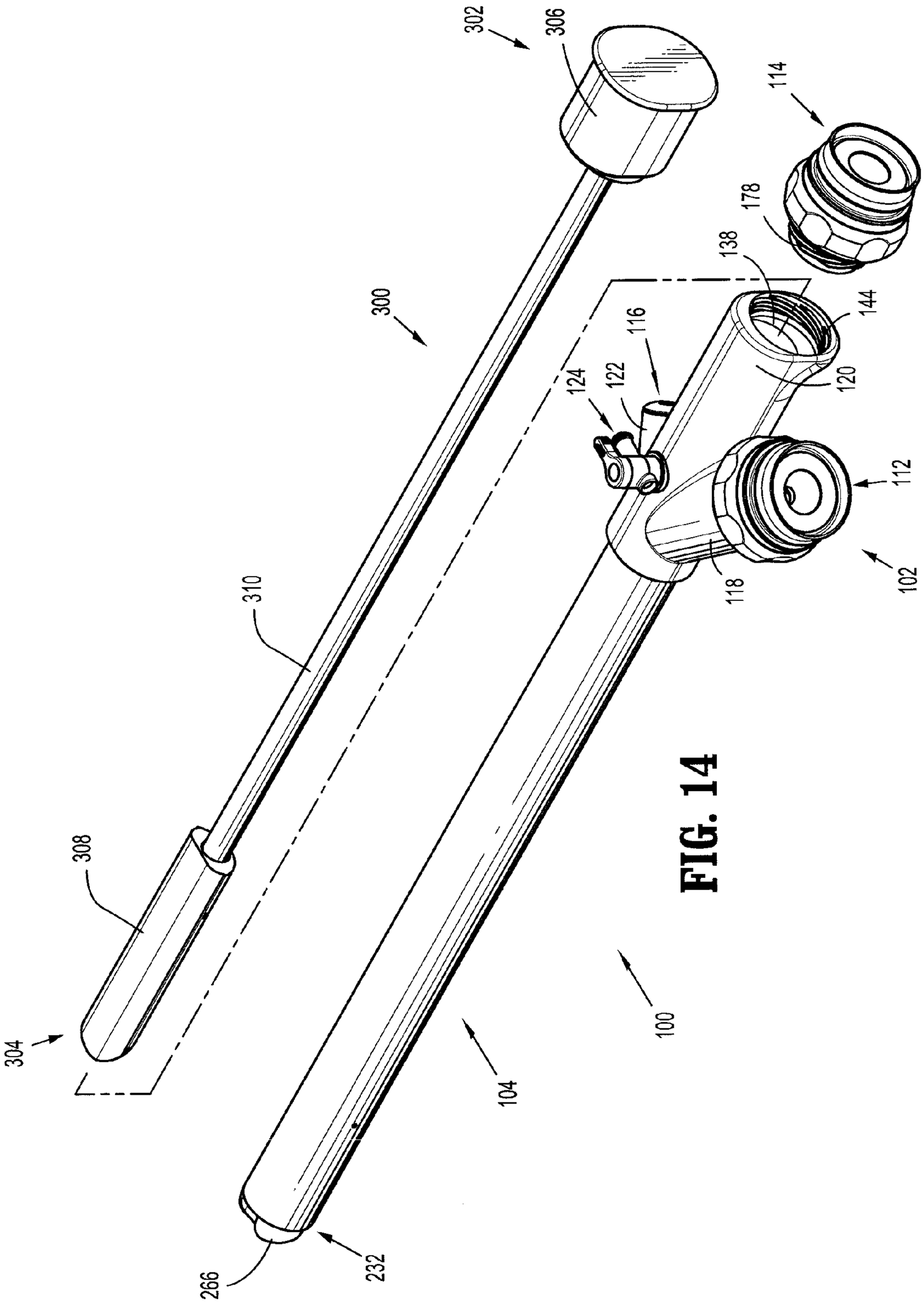
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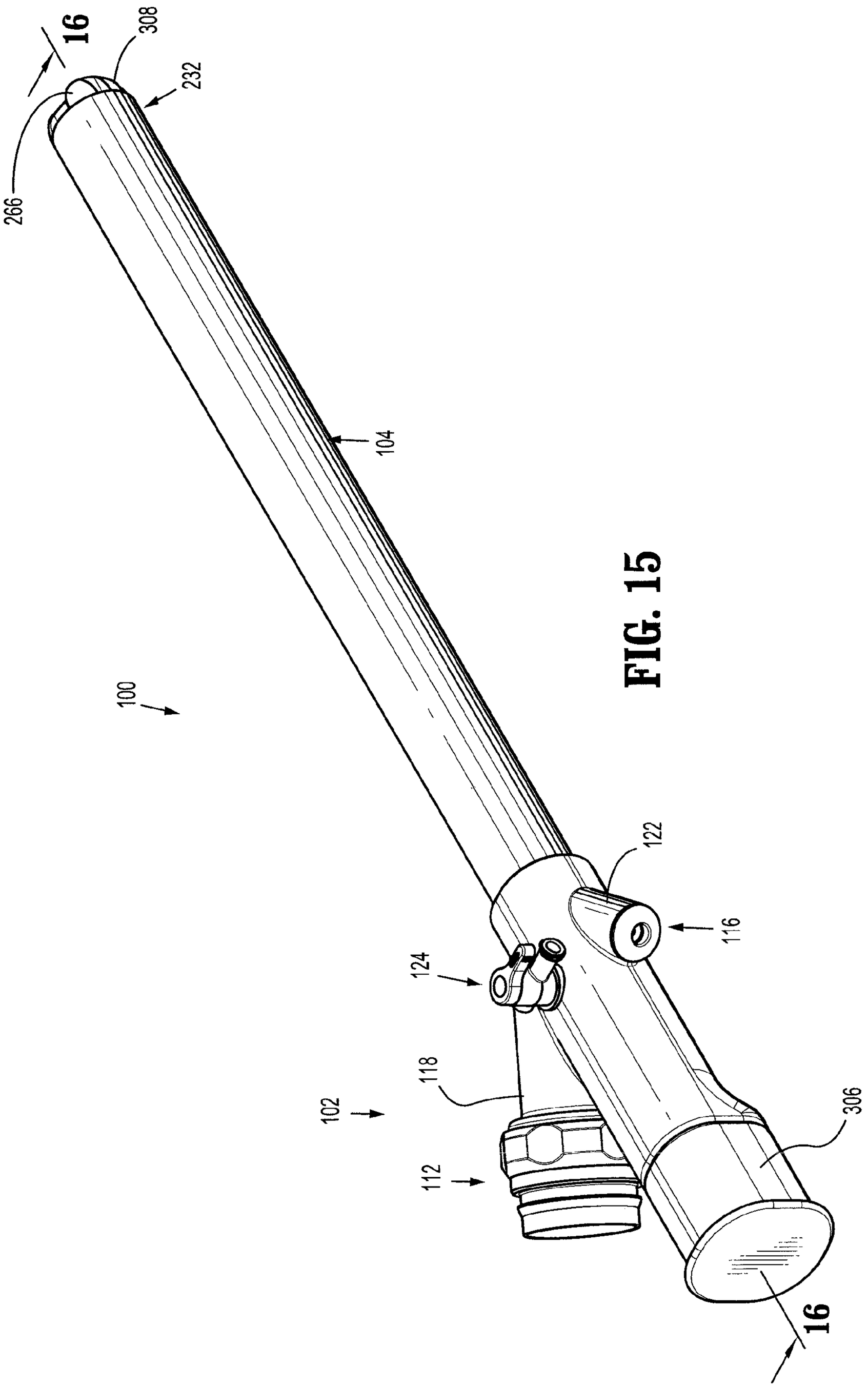
FIG. 14



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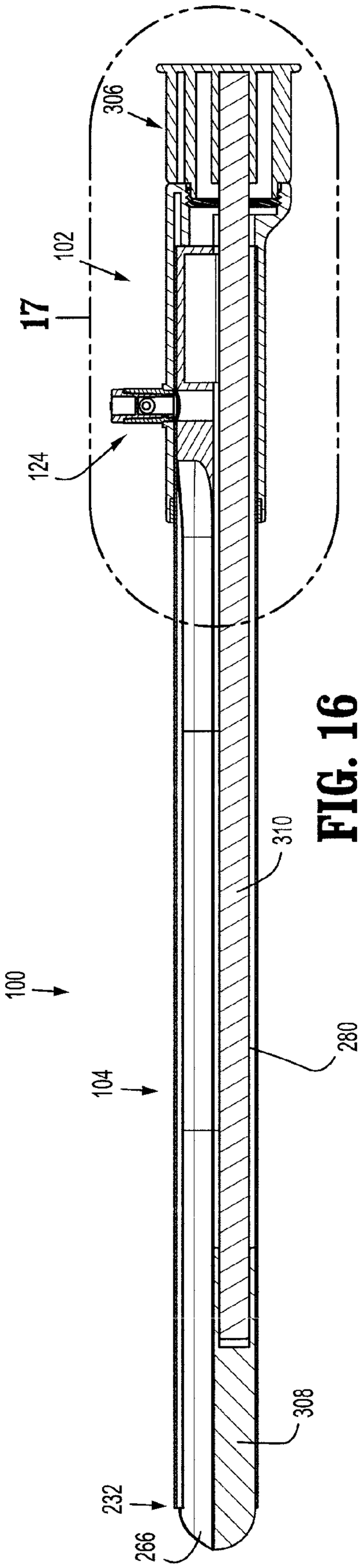

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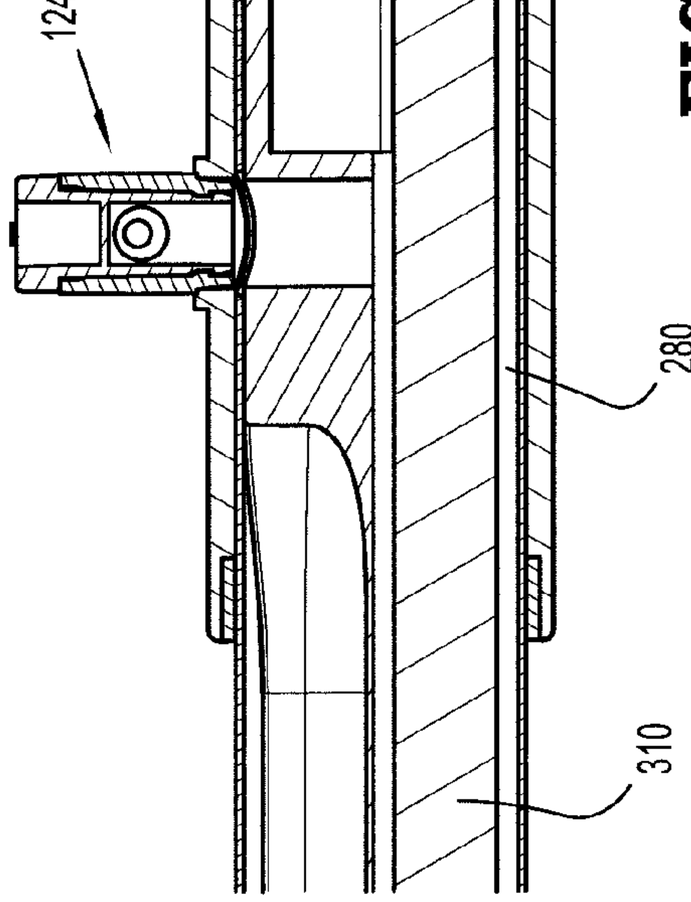

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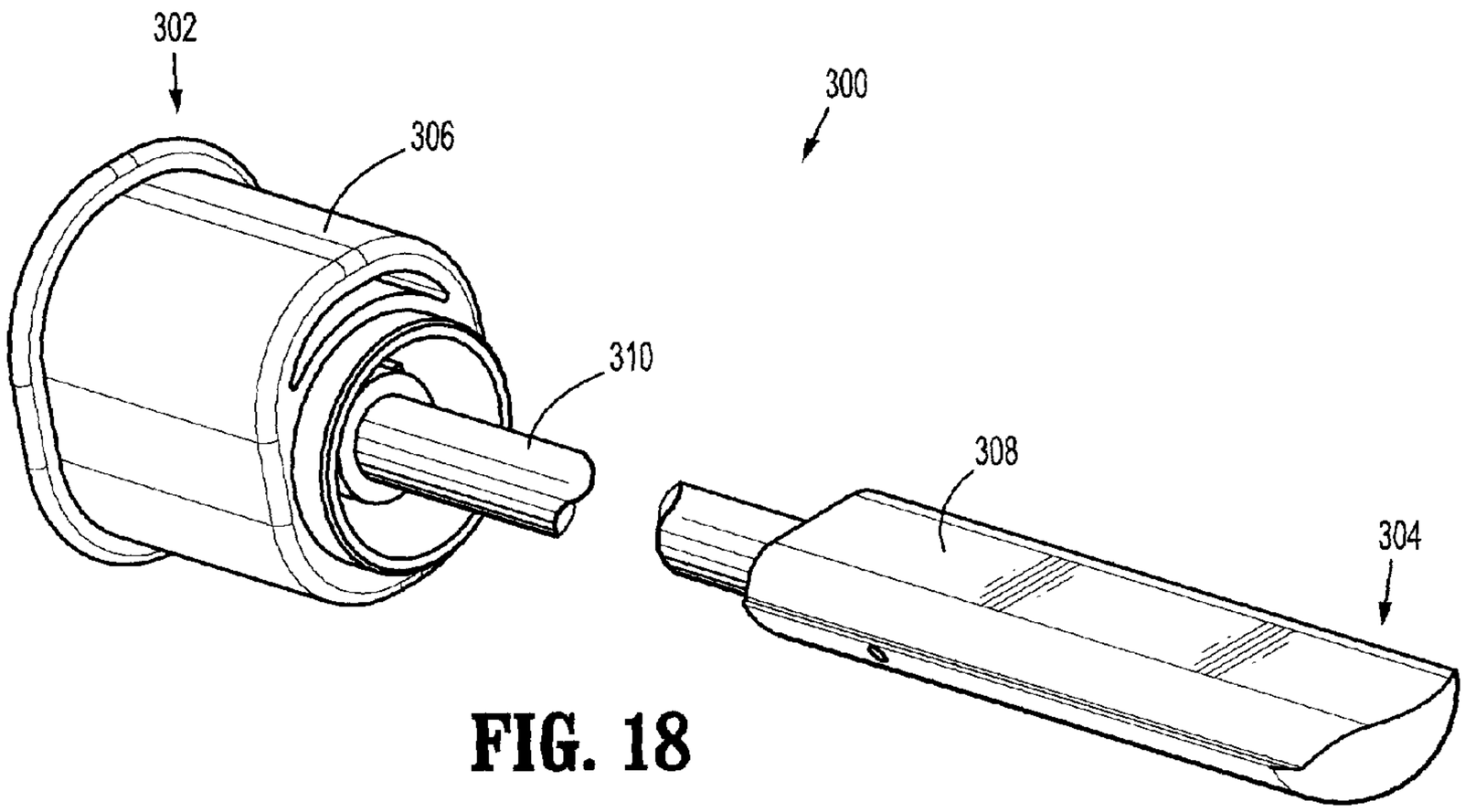

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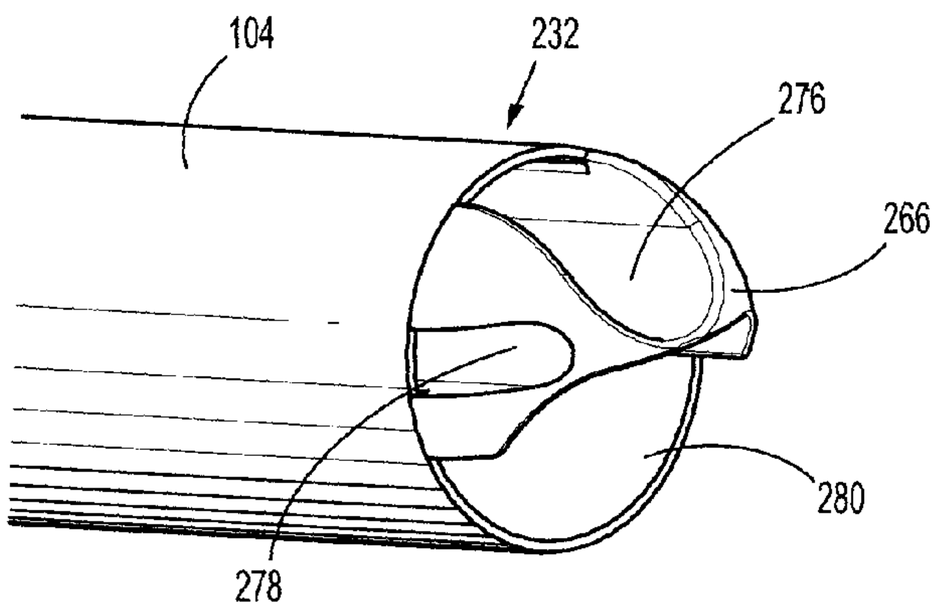

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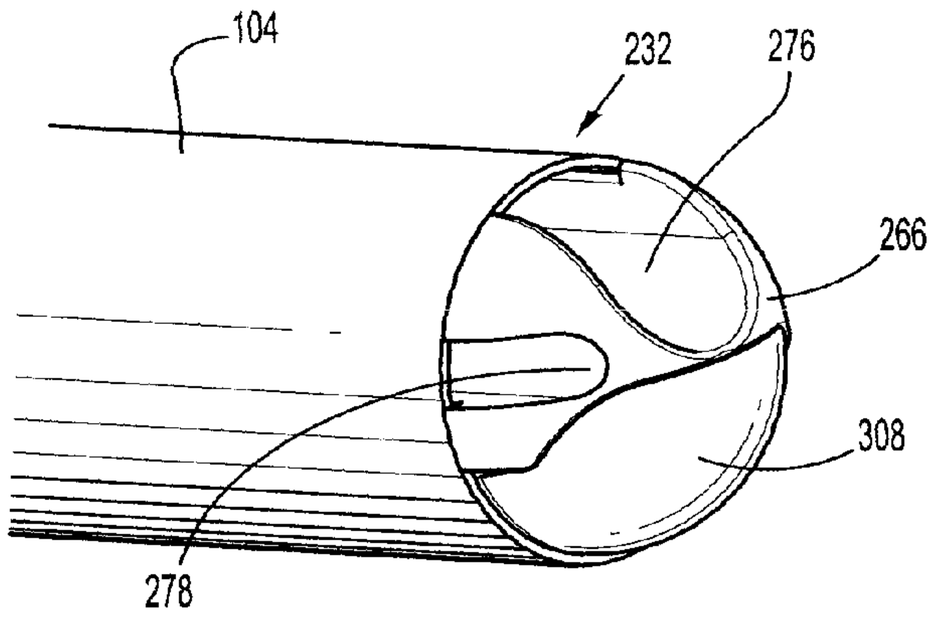

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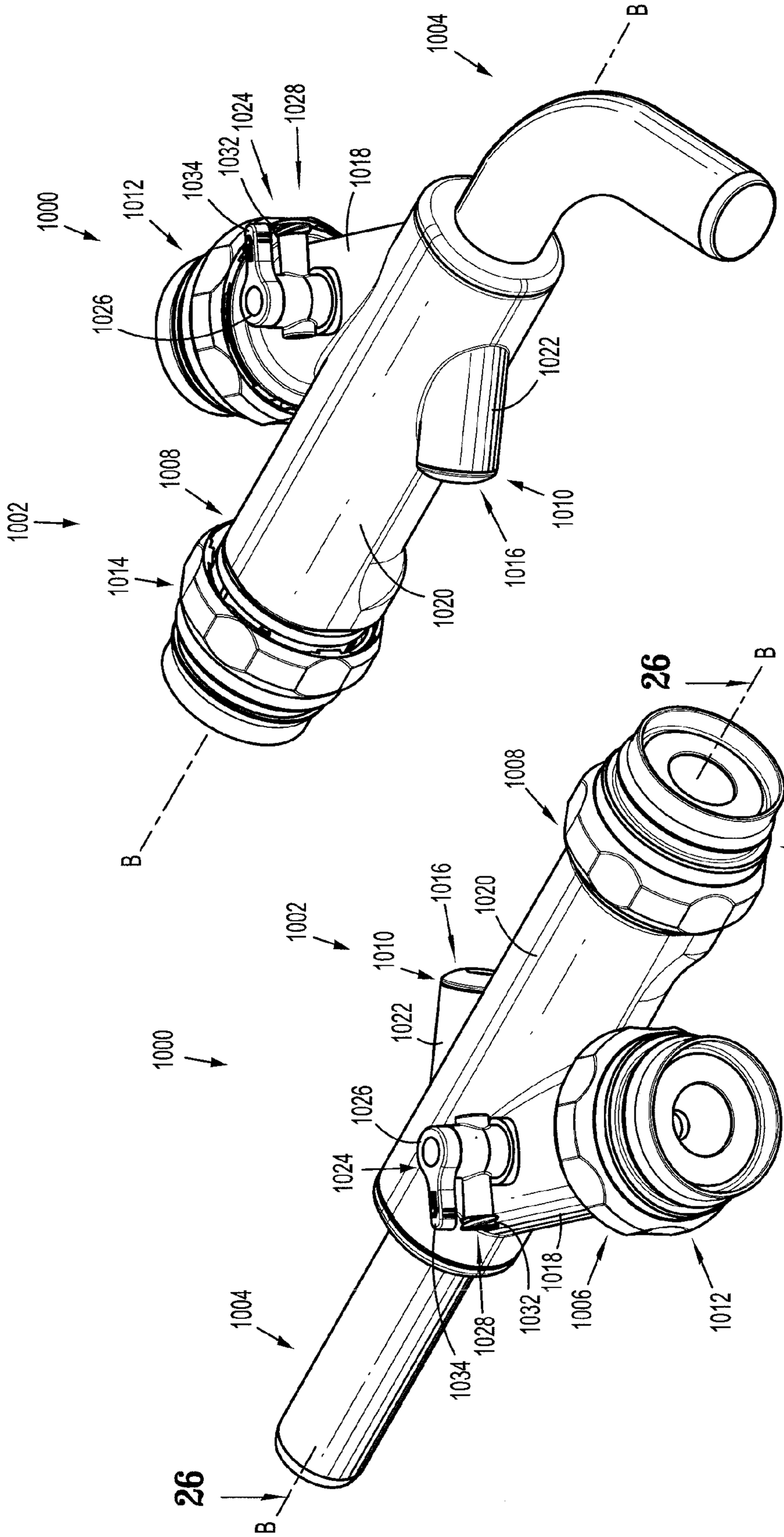
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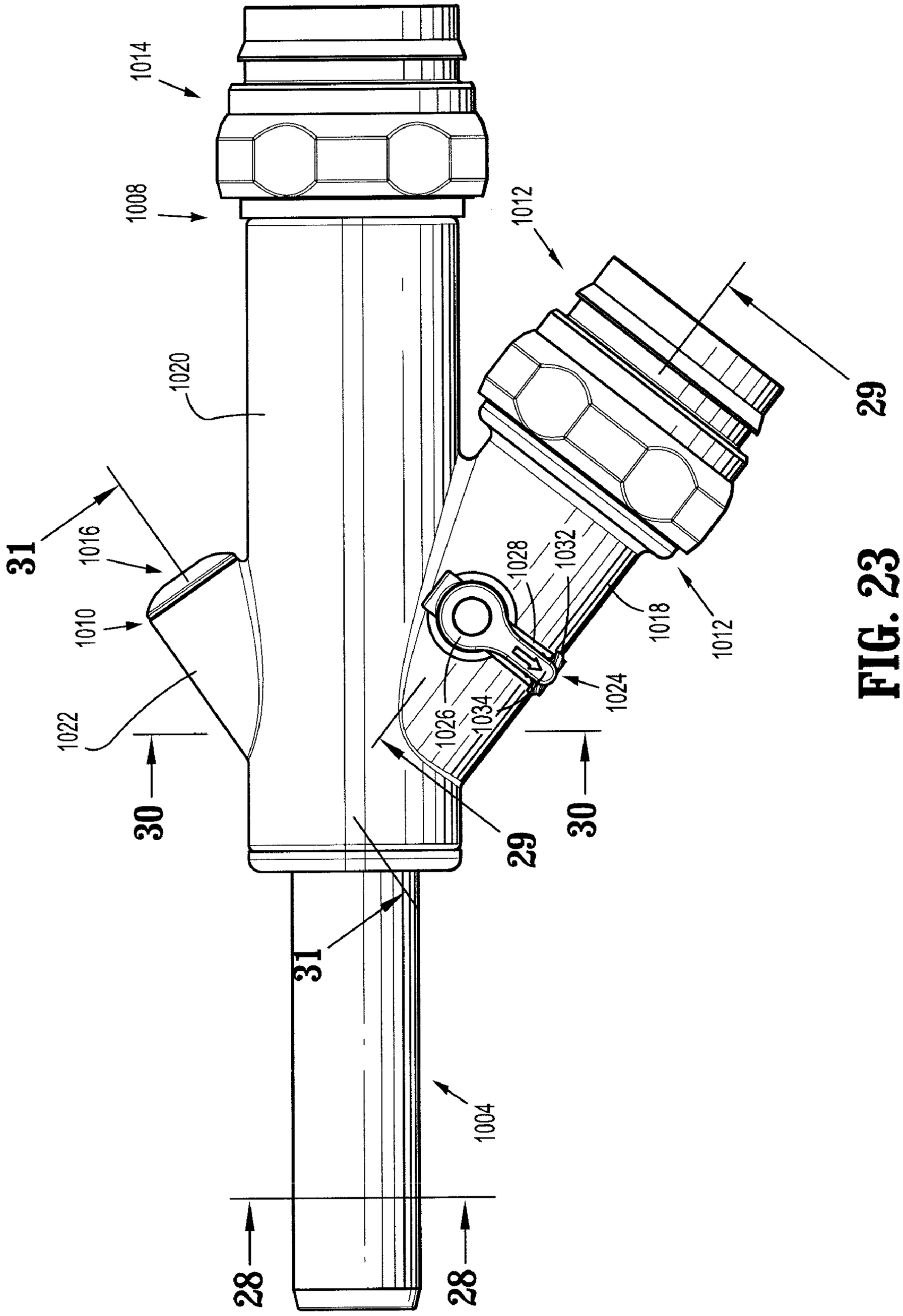
FIG. 22

FIG. 21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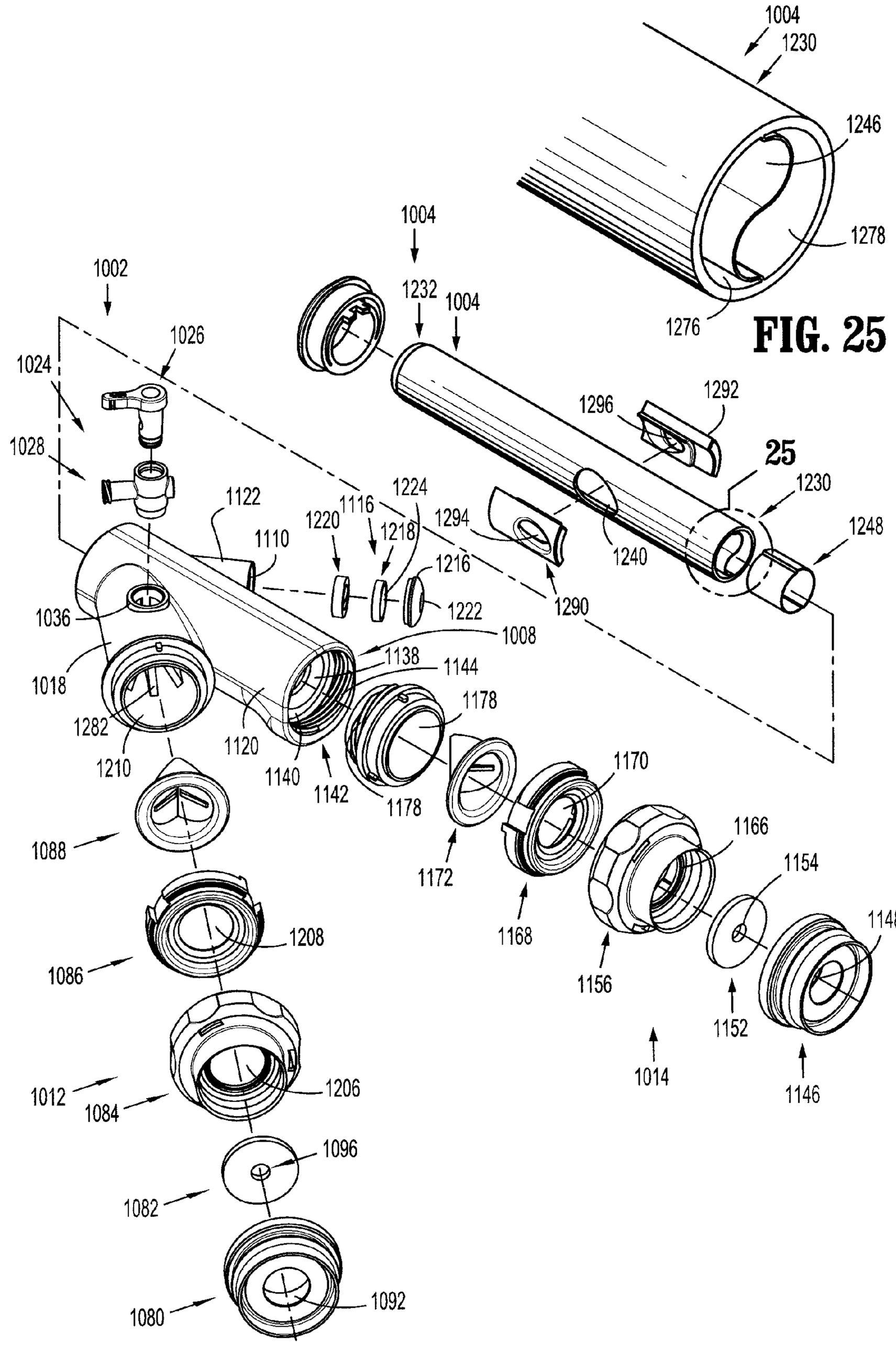
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FIG. 24

FIG. 25

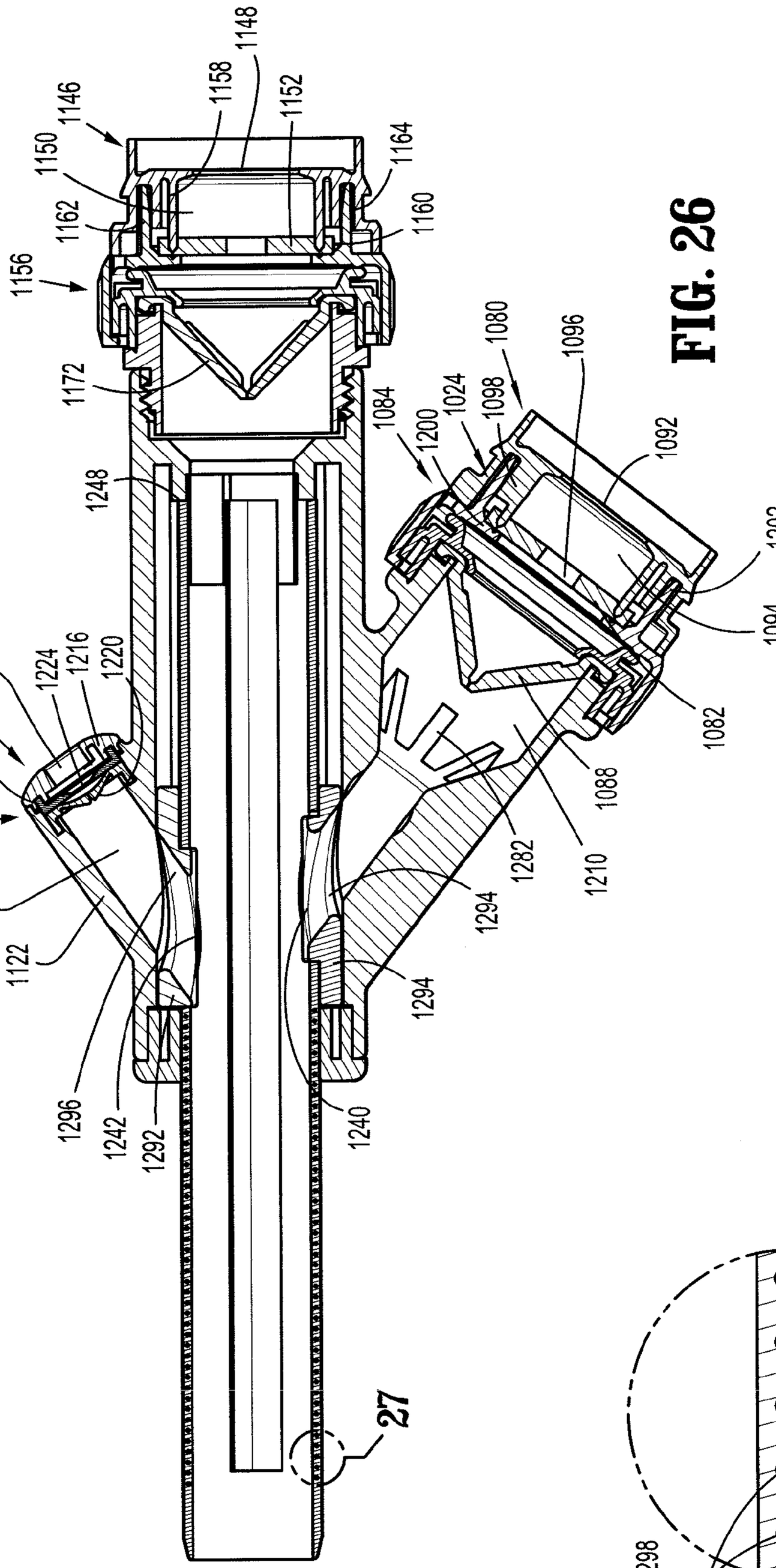
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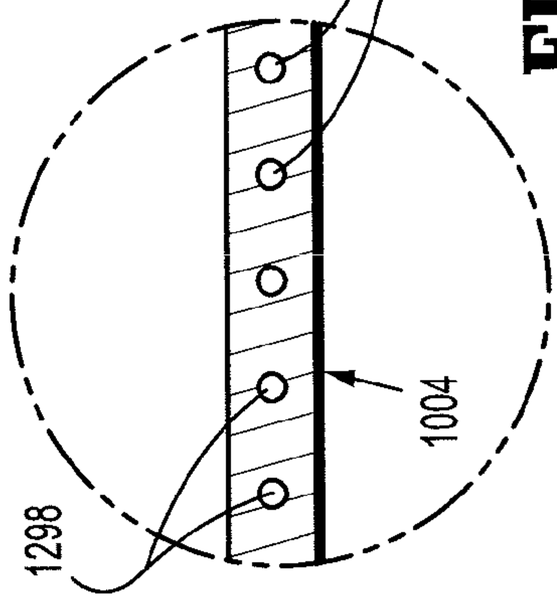
FIG. 26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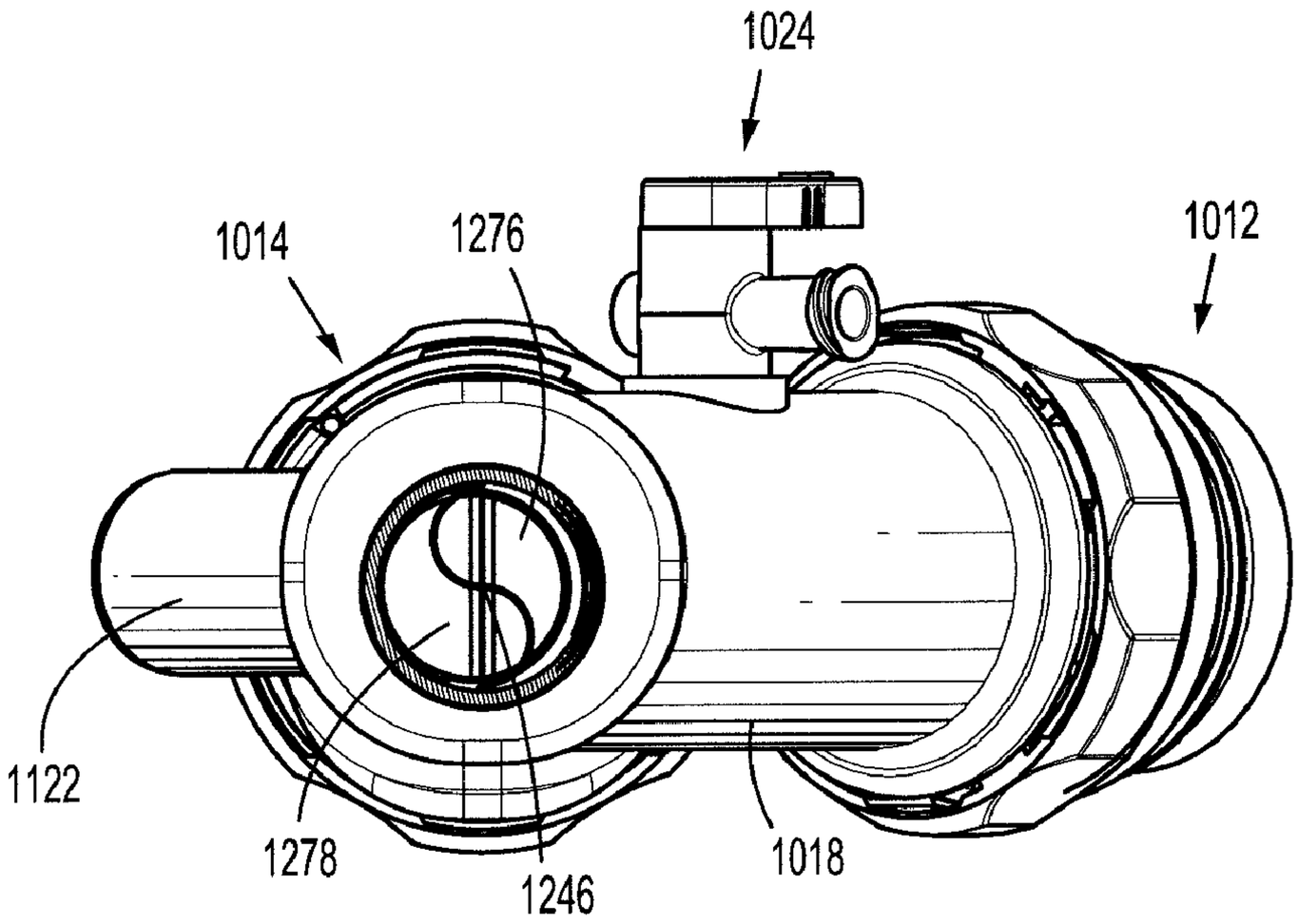
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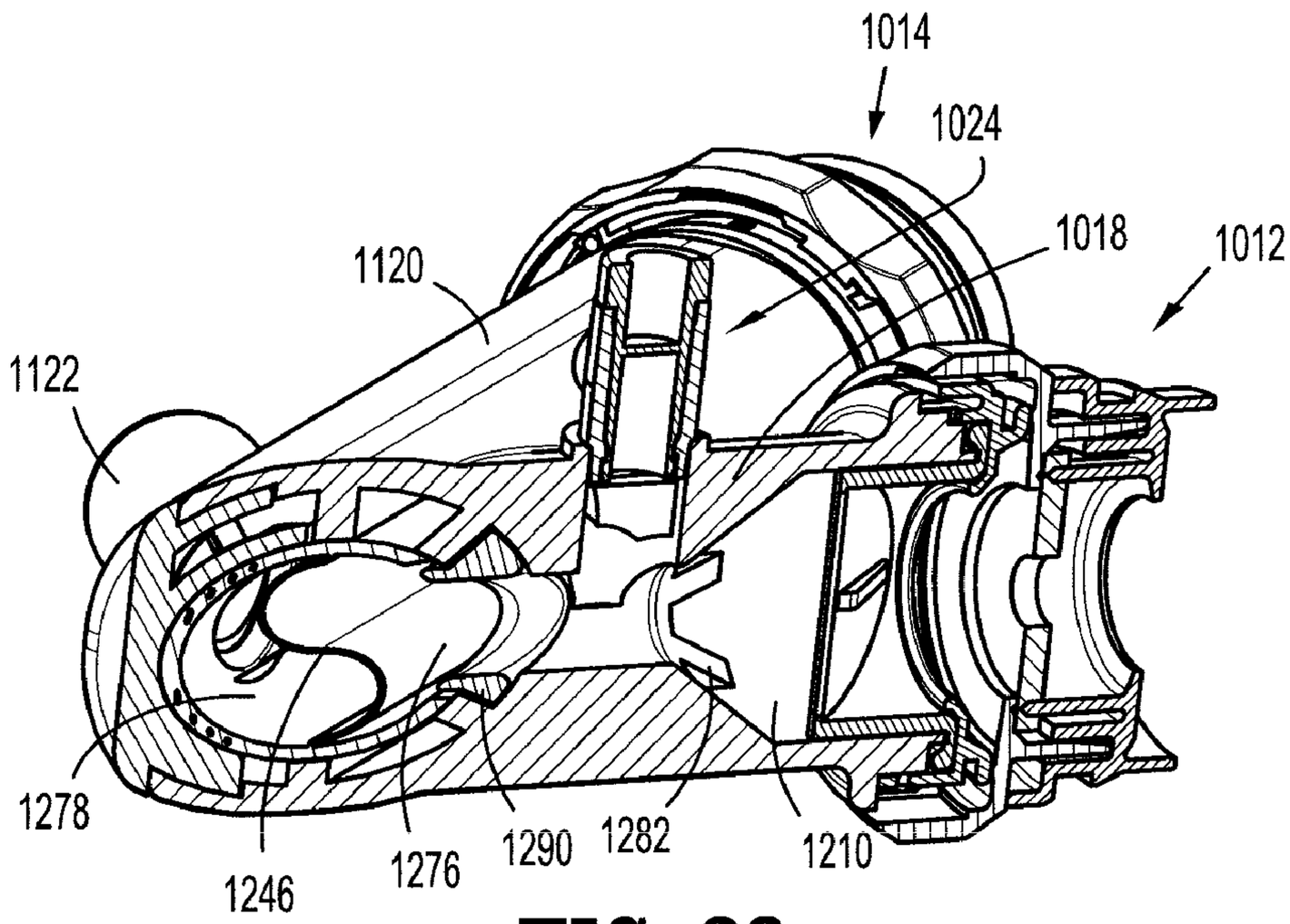
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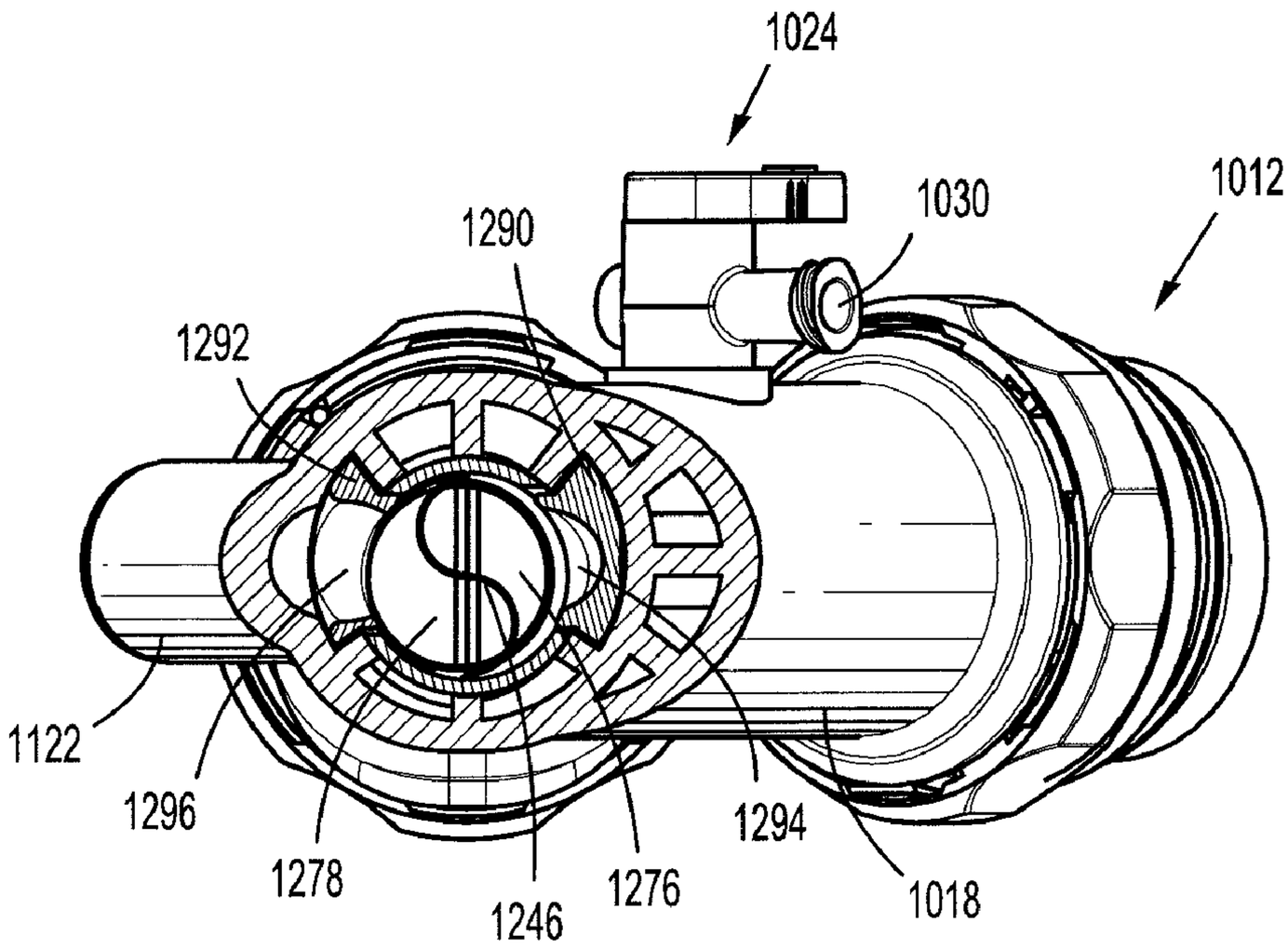
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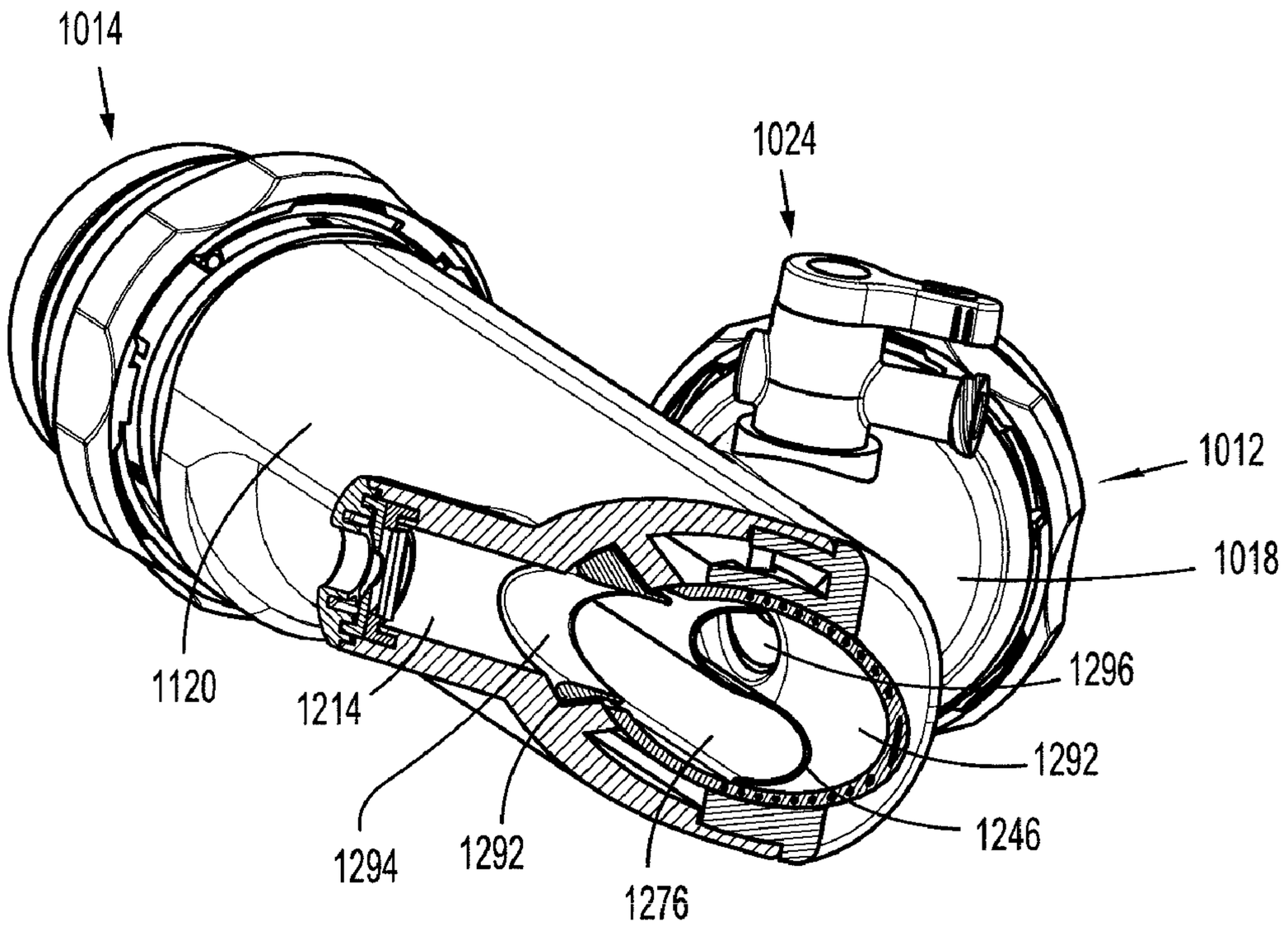
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FIG. 31

ENDOLUMINAL ACCESS DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This applications claims priority to and the benefit of U.S. Provisional Patent Application 61/023,644, filed on Jan. 25, 2008, which is incorporated by reference in its entirety.

BACKGROUND

1. Technical Field

The present disclosure relates to surgical instruments and methods. More particularly, the present disclosure relates to an endoluminal access device.

2. Background of Related Art

Endoluminal surgery encompasses all surgical procedures that involve intentional instrument penetration into a lumen of a human body, such as vascular lumens, gastrointestinal lumens, or air exchange lumens. For example, endoluminal surgery may be performed by introducing a surgical instrument through the esophagus, rectum, vagina, urethra or bladder. These procedures generally entail diagnosis or treatment of diseases or debilitating conditions. Surgeons usually utilize a rigid or flexible tube, such as an endoscope, during endoluminal surgery. The tube is normally introduced into the human body through a body orifice, such as the mouth or rectum, or through an incision. Endoscopes allow surgeons to view the target surgical site and may provide one or more working channels, or pathways, to the treatment site. During endoluminal surgical procedures, the surgeon steers or places the endoscope through the body until it reaches the intended site. Thereafter, the surgeon may perform the appropriate medical procedure.

SUMMARY

A surgical access apparatus for providing access inside a body includes a housing having a first port, a tubular member extending distally from the housing and defining a longitudinal axis therealong, wherein the tubular member includes a lumen extending therethrough. a shaft insert disposed in the lumen of the tubular member, wherein the shaft insert forms first, second, and third passageways extending along the lumen of the tubular member, wherein each of the first, second, and third passageways is adapted to receive a surgical instrument; and a first seal assembly covering the first port of the housing and defining a first passage disposed in communication with the first passageway defined by the shaft insert in the tubular member, wherein the first seal assembly is adapted to form a seal around the surgical instrument inserted through the first passage of the first seal assembly.

In one embodiment, the tubular member is made of a one of rigid material and a flexible material.

In one embodiment, the housing includes a first tubular portion defining an axis that is at an oblique angle relative to the longitudinal axis of the tubular member.

In one embodiment, the first tubular portion of the housing includes a bore disposed in fluid communication with the first port.

In one embodiment, the housing includes a second port and a third port, each of the second and third ports being adapted to receive a surgical instrument.

In one embodiment, wherein the housing includes a second tubular portion having a bore, the bore being disposed in communication with the second port and the second passageway.

In one embodiment, the second tubular portion of the housing defines an axis that is oriented substantially parallel to the longitudinal axis of the tubular member.

In one embodiment, the access apparatus further includes a second seal assembly releasably connected to the second tubular portion of the housing, the second seal assembly having passage disposed in communication with the second passageway, wherein the seal assembly is adapted to form a seal around a surgical instrument inserted through the second passage.

In one embodiment the second passageway is configured to receive an obturator in the absence of the second seal assembly.

In one embodiment, the housing includes a third tubular portion having a bore, the bore being disposed in communication with the third port and the third passageway.

In one embodiment, the third tubular portion of the housing defines an axis that is at an oblique angle relative to the longitudinal axis of the tubular member.

In one embodiment, the third passageway is configured to receive an endoscope.

The present application further relates to another embodiment of a surgical access apparatus for providing access inside a body. This embodiment includes a housing having a first port, a tubular member extending distally from the housing and defining a longitudinal axis therealong, wherein the tubular member includes a lumen extending therethrough, a dividing wall positioned along the lumen of the tubular member, the dividing wall having a substantially S-shaped transverse cross-sectional profile, wherein the substantially dividing wall divides the lumen into first and second passageways, wherein each of the first and second passageways is adapted to receive a surgical instrument, and a first seal assembly covering the first port of the housing and defining a first passage disposed in communication with the first passageway defined by the shaft insert in the tubular member, wherein the first seal assembly is adapted to form a seal around the surgical instrument inserted through the first passage of the first seal assembly.

In one embodiment, the tubular member is made of a one of rigid material and a flexible material.

In one embodiment, the housing includes a first tubular portion defining an axis that is at an oblique angle relative to the longitudinal axis of the tubular member.

In one embodiment, the first tubular portion of the housing includes a bore disposed in fluid communication with the first port.

In one embodiment, the housing includes a second port and a third port, each of the second and third ports being adapted to receive a surgical instrument.

In one embodiment, the housing includes a second tubular portion having a bore, the bore being disposed in communication with the second port and the second passageway.

In one embodiment, the second tubular portion of the housing defines an axis that is oriented substantially parallel to the longitudinal axis of the tubular member.

In one embodiment, the dividing wall is made of at least one of a flexible and resilient material.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the presently disclosed access device are described herein with reference to the accompanying drawings, wherein:

FIG. **1** is a perspective view of an access apparatus according to an embodiment of the present disclosure;

FIG. **2** is a perspective view of a proximal portion of the access apparatus shown in FIG. **1**;

FIG. **3** is a top view of the access apparatus shown in FIG. **1**;

FIG. **4** is a side view of the access apparatus shown in FIG. **1**;

FIG. **5** is a perspective view, with parts separated, of the access apparatus shown in FIG. **1**;

FIG. **6** is a side cross-sectional view of the access apparatus shown in FIG. **1**, taken along section line **6-6** of FIG. **3**;

FIG. **7** is an enlarged view of the indicated area of detail of FIG. **6**;

FIG. **8** is a top cross-sectional view of the access apparatus shown in FIG. **1**, taken along section line **8-8** of FIG. **4**;

FIG. **9** is an enlarged view of the indicated area of detail of FIG. **8**;

FIG. **10** is a front view of the access apparatus shown in FIG. **1**;

FIG. **11** is a perspective cross-sectional view of the access apparatus shown in FIG. **1**, taken along section line **11-11** of FIG. **3**;

FIG. **12** is a perspective cross-sectional view of the access apparatus shown in FIG. **1**, taken along section line **12-12** of FIG. **3**;

FIG. **13** is a front cross-sectional view of the access apparatus shown in FIG. **1**, taken along section line **13-13** of FIG. **4**;

FIG. **14** is a perspective view of an obturator, and the access apparatus shown in FIG. **1** with a seal assembly detached therefrom;

FIG. **15** is a perspective view of the access apparatus shown in FIG. **1** with the obturator depicted in FIG. **14** inserted therein;

FIG. **16** is a side cross-sectional view of the access apparatus and obturator shown in FIG. **15**, taken along section line **16-16** of FIG. **15**;

FIG. **17** is an enlarged view of the indicated area of detail of FIG. **16**;

FIG. **18** is a perspective view showing the proximal and distal portions of the obturator depicted in FIG. **14**;

FIG. **19** is a perspective view of a distal portion of the access apparatus shown in FIG. **1** without the obturator being introduced in the access apparatus;

FIG. **20** is a perspective view of the distal portion of the access apparatus shown in FIG. **1** with the obturator inserted into the access apparatus;

FIG. **21** is a perspective view of an access apparatus with a flexible shaft according to another embodiment of the present disclosure;

FIG. **22** is a perspective view of the access apparatus depicted in FIG. **21** showing the flexible shaft bent relative to the longitudinal axis B-B;

FIG. **23** is a top view of the access apparatus depicted in FIG. **21**;

FIG. **24** is a perspective view, with parts separated, of the access apparatus depicted in FIG. **21**;

FIG. **25** is an enlarged view of the indicated area of detail of FIG. **24**;

FIG. **26** is a side cross-sectional view of the access apparatus depicted in FIG. **21**, taken along section line **26-26** of FIG. **21**;

FIG. **27** is an enlarged view of the indicated area of detail of FIG. **26**;

FIG. **28** is a front cross-sectional view of the access apparatus depicted in FIG. **21**, taken along section line **28-28** of FIG. **23**;

FIG. **29** is a perspective cross-sectional view of the access apparatus depicted in FIG. **21**, taken along section line **29-29** of FIG. **23**;

FIG. **30** is a front cross-sectional view of the access apparatus depicted in FIG. **21**, taken along section line **30-30** of FIG. **23**; and

FIG. **31** is a perspective cross-sectional view of the access apparatus depicted in FIG. **21**, taken along section line **31-31** of FIG. **23**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Embodiments of the presently disclosed access apparatus will now be described in detail with reference to the drawings wherein like reference numerals identify similar or identical elements. In the drawings and in the description which follows, the term "proximal," as is traditional, will refer to the end of the access apparatus that is closest to the operator, while the term "distal" will refer to the end of the access apparatus that is farthest from the operator. In the present disclosure, the words "a," "an," or "the" are to be taken to include both the singular and the plural. Similarly, any reference to plural items shall, where appropriate, include the singular.

The present disclosure relates to an endoluminal access apparatus for use in surgical procedures. The access apparatus provides access to a working space inside a human body. Physicians can utilize the presently disclosed access device in many kinds of surgical procedures including, but not limited to, endoluminal, transvaginal, endoscopic and laparoscopic procedures. In addition, the access apparatus of the present disclosure can be employed in combination with any suitable surgical instrument.

Referring initially to FIGS. **1-4**, an access apparatus is generally designated with reference numeral **100**. Access apparatus **100** includes a housing **102** and a shaft or tubular member **104**. In one embodiment, tubular member **104** is made of a rigid material. Tubular member **104** extends distally from housing **102** and defines a longitudinal axis A-A therealong. Housing **102** includes a first tubular portion **118**, a second tubular portion **120**, and a third tubular portion **122**. Second tubular portion **120** is oriented substantially parallel to longitudinal axis A-A, whereas first and third tubular portions **118**, **122** each define an axis that is at an oblique angle relative to longitudinal axis A-A. First and third tubular portions **118**, **122** converge into second tubular portion **120** of housing **102**.

First tubular portion **118** of housing **102** defines a first port **106** adapted to receive a surgical instrument. Second tubular portion **120** defines a second port **108** configured to receive a surgical instrument. Third tubular portion **122** defines a third port **110** adapted to receive a surgical instrument. Each of the first port **106**, second port **108**, and third port **110** provides a passage into an inner portion of housing **102**.

Housing **102** further includes first, second, and third seal assemblies **112**, **114**, **116**, respectively. Each of the first, second and third seal assemblies **112**, **114**, **116** covers first port **106**, second port **108**, and third port **110**, respectively. As will be discussed in detail below, first, second, and third seal assemblies **112**, **114**, **116** form a seal around a surgical instrument when said surgical instrument is inserted through first, second, and third ports **106**, **108**, **110**, respectively. Also, second and third seal assemblies **114**, **116** are configured to remain closed in the absence of a surgical instrument extending therethrough.

In addition to seal assemblies **112**, **114**, **116**, housing **102** includes an insufflation assembly **124** configured to be connected to a source of insufflation gases or a vacuum system (not shown). Insufflation assembly **124** incorporates an insufflation port **128** and a stop-cock valve **126**. Insufflation port **128** defines a lumen **130** disposed in fluid communication with an inner portion of housing **102** and includes an external thread **132** for facilitating connection to a source of insufflation gases or a vacuum system.

Stopcock valve **126** has an open position and a closed position. Thus, stopcock valve **126** is capable of controlling fluid flow through insufflation assembly **124**. In the open position, stopcock valve **126** allows fluid flow through insufflation assembly **124**. In the closed position, stopcock valve **126** prevents or hinders fluid flow through insufflation assembly **124**. In one embodiment, stopcock valve **126** includes a lever **134** extending therefrom. Lever **134** facilitates rotation of stopcock valve **126** with respect to housing **202**. In use, a user actuates stopcock valve **126** between the open and closed positions by rotating stopcock valve **126** relative to housing **102** through lever **134**. While a stopcock valve is shown and described, it is envisioned that any suitable valve capable of permitting and restricting fluid flow, may be provided in insufflation assembly **124**.

With reference to FIGS. **5-9**, housing **102** defines an opening **136** configured to receive a portion of insufflation assembly **124**. Opening **136** is disposed in fluid communication with insufflation port **128** and allows fluid flow between a source of insufflation gases or a vacuum system and an inner portion of housing **102** when insufflation port **128** is fluidly coupled to the source of insufflation gases or vacuum system. In the depicted embodiment, opening **136** is positioned on second tubular portion **120** of housing **102**. It is contemplated that opening **136** can nevertheless be located on any part of housing **102**.

As seen in FIGS. **5-9**, first seal assembly **112** is fixed to first tubular portion **118** of housing **102**. First seal assembly **112** includes a cover **180**, an instrument seal **182**, a knob **184**, a seal cover **186**, and a duckbill valve **188**. Cover **180** defines an opening **192** extending therethrough. Opening **192** is dimensioned to receive a surgical instrument and leads to an inner cavity **194** (see FIG. **9**) of cover **180**. Inner cavity **194** is configured to receive instrument seal **182**. Instrument seal **182** defines an aperture **196** extending therethrough. Aperture **196** is dimensioned to receive a surgical instrument. In operation, instrument seal **182** forms a fluid-tight seal around a surgical instrument when the surgical instrument is inserted through aperture **196**.

First seal assembly **114** can be connected to port **106** by snapping knob **184**s onto port **106**. It is envisioned, however, that first seal assembly **112** may be connected to port **106** by any suitable means. When first seal assembly **112** is assembled, instrument seal **182** is located between cover **180** and knob **184**. As seen in FIG. **9**, cover **180** includes a ring **198** protruding distally therefrom. Ring **198** presses instrument seal **182** against a proximal wall **200** of knob **184**. Knob **184** includes a ring **202** protruding proximally therefrom. Ring **202** is adapted to be received inside an annular space **204** formed in cover **180**. During assembly, ring **202** is positioned inside annular space **204** to facilitate interconnection between cover **180** and knob **184**.

Knob **184** further includes a longitudinal opening **206** configured to receive a surgical instrument and at least a portion of seal cover **186**. Seal cover **186** includes a hole **208** adapted to receive a surgical instrument and, during operation, aids in securing duckbill valve **188** to first seal assembly **112** and first tubular member **118**. Duckbill valve **188** is partially disposed in a bore **210** of first tubular portion **118**. In operation, duckbill valve **188** forms a fluid-tight seal around a surgical instrument inserted therethough and closes in the absence of a surgical instrument extending therethrough.

As discussed above, duckbill valve **188** is positioned in bore **210** of first tubular portion **118**. Bore **210** extends through first tubular portion **118** and is dimensioned to receive not only duckbill valve **188** but also a surgical instrument and a lead-in insert **190**. During use, lead-in insert **190** guides the insertion of a surgical instrument through first tubular portion **118**. Lead-in insert **190** is in the form of a C-shaped channel and defines a passage **212** therealong. Passage **212** is dimensioned to slidably receive a surgical instrument such as an endoscope. During use, passage **212** of lead-in insert **190** steers a surgical instrument inserted through first tubular portions **118** toward second tubular portion **120** of housing **202**.

As seen in FIGS. **5-9**, second tubular portion **120** of housing **102** has inner surfaces **140** forming a bore **138**. Bore **138** extends through second tubular portion **120** and is dimensioned to receive a portion of tubular member **104** and a portion of first seal assembly **114**. Second tubular portion **120** additionally includes an inner thread **144** formed about a proximal end **142** of inner surfaces **140**. Inner thread **144** is adapted to threadedly engage a portion of second seal assembly **114**.

Second seal assembly **114** covers second port **108** and includes a cover **146** defining an opening **148**. Opening **148** extends through cover **146** and is dimensioned to receive a surgical instrument. Moreover, opening **148** leads to an inner cavity **150**, as seen in FIG. **7**, defined in cover **146**. Inner cavity **150** of cover **146** is configured to receive an instrument seal **152**.

Instrument seal **152** defines an aperture **154** dimensioned to receive a surgical instrument. In use, instrument seal **152** forms a fluid-tight seal around a surgical instrument inserted through aperture **154**. When second seal assembly **114** is assembled, instrument seal **152** is positioned between cover **146** and knob **156**. Cover **146** includes a ring **158** protruding distally therefrom, as seen in FIG. **7**. Ring **158** presses instrument seal **152** against a proximal wall **160** of knob **156**, thereby securing instrument seal **152** between cover **146** and knob **156**. Knob **156** includes a ring **162** protruding proximally therefrom. Ring **162** is adapted to be received within an annular space **164** formed in cover **146**. During assembly, ring **162** is placed within annular space **164** to facilitate interconnection between cover **146** and knob **156**.

Knob **156** further includes a longitudinal opening **166** configured to receive a surgical instrument and at least a portion of a seal cover **168**. Seal cover **168** includes a hole **170** adapted to receive a surgical instrument and, during use, helps secure a duckbill valve **172** within second seal assembly **114**. Duckbill valve **172** is disposed between seal cover **168** and a threaded adapter **174**. Duckbill valve **172** is adapted to form a fluid-tight seal around a surgical instrument inserted therethrough and close in the absence of a surgical instrument extending therethrough. A portion of duckbill **175** is located inside threaded adapter **174**.

With continued reference to FIGS. **5-9**, threaded adapter **174** releasably secures second seal assembly **114** to second tubular portion **120** of housing **102**. Threaded adapter **174** includes an external thread **178** formed thereabout and a longitudinal bore **176** adapted to receive a surgical instrument and at least a portion of duckbill seal **175**. External thread **178** is configured to threadedly engage inner thread **144** of second tubular portion **120**. In operation, the user can release or attach second seal assembly **113** to second tubular portion

120 by inserting at least a portion of threaded adapter **174** in bore **138** of second tubular portion **120** and then rotating second seal assembly **114**, via knob **156**, with respect to second tubular portion **120**. While second seal assembly **114** rotates relative to second tubular portion **120**, external thread **178** engages or disengages inner thread **144**. When external thread **178** engages inner thread **144**, second seal assembly **114** is connected to second tubular portion **120**. Conversely, second seal assembly **114** detaches from second tubular portion **120** when external thread **178** disengages from inner thread **144** of second tubular portion **120** of housing **202**.

As seen in FIG. **9**, third tubular portion **122** of housing **202** defines a bore **214** dimensioned to receive a surgical instrument. Bore **214** is disposed in fluid communication with third port **110**. Third seal assembly **116** covers third port **110** and includes a cap **216**, an instrument seal **218**, and a duckbill valve **220**. Cap **216** has a hole **222** extending therethrough. Hole **222** is dimensioned to receive a surgical instrument and leads to bore **214** of third tubular portion **122**. Instrument seal **218** is secured between cap **216** and duckbill valve **220** and defines an opening **224**. Opening **224** is configured to receive a surgical instrument. In use, instrument seal **218** forms a fluid-tight seal around a surgical instrument inserted through opening **224**. Duckbill valve **220** is adapted to form a fluid-tight seal around a surgical instrument inserted therethrough and close in the absence of a surgical instrument extending therethrough.

As seen in FIG. **9**, access apparatus **100** further includes a compression ring **226** adapted to be disposed in a distal end **228** of bore **138** of second tubular portion **120**. When access apparatus **100** is assembled, compression ring **226** is positioned between housing **102** and tubular member **104**. Compression ring **226** compresses tubular member **104** inwardly, thus securing tubular member **104** to housing **104**.

As seen in FIG. **5-9**, tubular member **104** has a proximal portion **230** and a distal portion **232** Moreover, tubular member **104** includes a proximal opening **236**, a distal opening **238** and a lumen **234** extending therethrough. Lumen **234** fluidly couples proximal and distal openings **236**, **238**. Proximal portion **230** of tubular member **104** is disposed within bore **138** of second tubular portion **120** of housing **202**. Proximal portion **230** of tubular member **104** includes an aperture **240** for establishing fluid communication between bore **210** of first tubular portion **118** and lumen **234** of tubular member **104**, an opening **242** for establishing fluid communication between insufflation assembly **124** and lumen **234**, and a hole **244** (see FIG. **9**) for establishing fluid communication between bore **214** of third tubular portion **122** and lumen **234**. When proximal portion **230** of tubular member **104** is positioned within housing **102**, aperture **240** is aligned with bore **210** of first tubular portion **118**, opening **242** is aligned with hole **136** of second tubular portion **120**, and hole **244** is aligned with bore **214** of third tubular portion **122**.

As seen in FIGS. **5-9**, access apparatus **100** further includes a shaft insert **246** adapted to be disposed in lumen **234** of tubular member **104**. Shaft insert **246** includes a proximal insertion member **248**, a middle insertion member **250**, and a distal insertion member **252**. Proximal, middle, and distal insertion members **248**, **250**, **252** are interconnected. Each of the proximal, middle, and distal insertion members **248**, **250**, **252** is adapted to be inserted inside lumen **234** of tubular member **104**.

Proximal insertion member **248** includes a hole **254** for facilitating fluid communication between insufflation assembly **124** and lumen **234** of tubular member **104**. As seen in FIG. **7**, when proximal insertion member **248** is located inside tubular member **104** and housing **102**, hole **254** is aligned with opening **242** of tubular member **104** and hole **136** of housing **102**. Proximal insertion member **248** defines a channel **256** configured to slidably receive a surgical instrument therethrough. Channel **256** has a longitudinal portion **258** and a curved portion **260**. As seen in FIG. **12**, curved portion **260** is located at a proximal section of channel **256** and leads to bore **210** of first tubular portion **118** when shaft insert **246** is disposed in lumen **234** of tubular member **104**.

As seen in FIGS. **5** and **6**, middle insertion member **250** is disposed between proximal insertion member **248** and distal insertion member **252** and defines a longitudinal channel **262**. Longitudinal channel **262** extends along the length of middle insertion member **250**. When shaft insert **246** and tubular member **104** are positioned in housing **102**, longitudinal channel **262** is longitudinally aligned with longitudinal portion **258** of channel **256** of proximal insertion member **248**.

As seen in FIGS. **5** and **8**, distal insertion member **252** also has a longitudinal channel **264** extending therealong. Longitudinal channel **264** aligns with longitudinal channel **262** of middle insertion member **250** when shaft insert **246** and tubular member **104** are connected to housing **102**. As seen in FIG. **10**, longitudinal channel **264**, longitudinal channel **262**, and channel **256** together form a passageway **276** disposed in communication with bore **210** of first tubular portion **118** of housing **102**. Distal insertion member **252** further includes an atraumatic blunt tip **266** at a distal end **268** thereof. Atraumatic blunt tip **266** prevents or minimizes damage to a patient when access apparatus **100** is inserted into the patient's body.

With reference to FIGS. **8-13**, proximal insertion member **248** includes a groove **270** extending along a lateral portion thereof. As seen in FIG. **9**, groove **270** is disposed in communication with bore **214** of third tubular portion **122** when tubular member **102** is coupled to housing **102**. Middle insertion member **250** also includes a groove **272** positioned laterally therealong. When middle insertion member **250** is connected to proximal insertion member **248**, groove **272** of middle insertion member **250** is longitudinally aligned with groove **270** of proximal insertion member **248**. Distal insertion member **252** defines a groove **274** extending along a lateral portion thereof. When distal insertion member **252** is coupled to middle insertion member **250**, groove **274** of distal insertion member **252** is longitudinally aligned with groove **272** of middle insertion member **250**. As seen in FIG. **10**, grooves **270**, **272**, **274** together form a passageway **278** adapted to slidably receive a surgical instrument. In one embodiment, the cross-sectional area of the passageway **278** formed by grooves **270**, **272**, **274** is smaller than the cross-sectional area of the passageway **276** formed by longitudinal channel **264**, longitudinal channel **262**, and channel **256**, as seen in FIG. **10**.

When shaft insert **246** is inserted into lumen **234** of tubular member **104**, shaft insert **246** partitions lumen in three passageways **276**, **278**, **280**. (See FIGS. **10** and **13**). As discussed above, passageway **276** is connected to bore **270** of first tubular portion **118**. Passageway **278** is disposed in communication with bore **214** of third tubular portion **122**. Passageway **280** is disposed in communication with bore **138** of second tubular portion **120**. In some embodiments, the cross-sectional area of passageway **280** is larger than the cross-sectional areas of passageways **276**, **278**.

With reference to FIG. **14-20**, passageway **280** is configured to accommodate at least a portion of an obturator **300**. Obturator **300** has a proximal portion **302** and a distal portion **304** and incorporates a handle **306**, an atraumatic blunt tip **308**, and a shaft **310**. Handle **306** is connected to a proximal end of shaft **310** of obturator **300** and facilitates grasping by a user. Atraumatic blunt tip **308** is connected to a distal end of

shaft **310** and aids in the insertion of access apparatus **100** inside a human body while preventing or minimizing damage to the body. In one embodiment, a transverse cross-section of atraumatic blunt tip **308** is substantially similar in profile to a cross-section of passageway **280**. In some embodiments, atraumatic blunt tip **308** has a substantially arcuate transverse cross-section.

Obturator **300** can be inserted inside access apparatus **100** through bore **138** of second tubular portion **120** once the user has removed second seal assembly **114** from housing **102**. To detach second seal assembly **114** from housing **102**, the user rotates knob **156** of second seal assembly **114** relative to housing **102**. As second seal assembly **114** rotates with respect to housing **102**, inner thread **175** of second seal assembly disengages inner thread **144** of housing **102**, releasing second seal assembly **114** from housing **104**. As seen in FIG. **15**, after detaching second seal assembly **114** from housing **102**, the user introduces obturator **300** into access apparatus **100** through bore **138** until atraumatic blunt tip **308** extends beyond distal portion **232** of tubular member **104**. As shown in FIGS. **16** and **17**, when obturator **300** is inserted inside access apparatus **100**, shaft **310** and a portion of atraumatic blunt tip **308** are disposed in passageway **280**. As shown in FIG. **19**, before obturator **300** is positioned within access apparatus **100**, passageway **280** has a distal open end. However, as depicted in FIG. **20**, once obturator **300** is positioned inside access apparatus **100**, the distal end of passageway **280** is blocked by atraumatic blunt tip **308**.

In operation, a user may use access apparatus **100** in conjunction with obturator **300** for a number of surgical procedures. For example, during one surgical procedure, the user may detach second seal assembly **114** from housing **102**, as described above, and the user may then place obturator **300** inside access apparatus **300**, as described above. The user may then introduce a tubular member **104** inside a patient's body via a body lumen such as the rectum or the vagina, and the user may then push access apparatus **100** distally until distal portion **232** of tubular member **104** has reached the target surgical site. Once tubular member reaches the target site, the user may then remove obturator **300** from access apparatus and reattach second seal assembly **114** to housing **102**. The user reattaches second seal assembly **114** to housing **102** in the manner described above.

Subsequently, the user may connect access apparatus **100** to a source of insufflation gases via insufflation assembly **124**. After fluidly coupling access apparatus **100** to a source of insufflation gases, the user may retract body tissue at the target surgical site by insufflating the body cavity with CO_2 or any other suitable insufflation gas. Before supplying the target site with insufflation gases, the user moves stop-cock valve **126** to the open position to allow fluid flow through insufflation assembly **124**. Following the retraction of body tissue, the user disconnects the source of insufflation gases from insufflation assembly **124**.

The user may then insert an endoscope (not shown) through first port **106** and slides the endoscope through passageway **276** until it reaches distal portion **232** of tubular member **104**. The endoscope gives the user the capability of observing the target site. While monitoring the target site with the endoscope, the user can also insert one or more surgical instruments through first and/or third ports **106**, **110** to simultaneously perform one or more surgical procedures through the same body opening.

With reference to FIGS. **21-23**, an alternate embodiment of access apparatus is designated with reference numeral **1000**. Access apparatus **1000** includes a housing **1002** and a tubular member **1004** extending distally from housing **1002**. In this embodiment, tubular member **1004** is made of a flexible material. Tubular member **1004** defines a longitudinal axis B-B when oriented in a straight position, as seen in FIG. **21**. Tubular member **1004** is capable of bending with respect to longitudinal axis B-B. (See FIG. **22**). The structure and operation of housing **1002** is substantially similar to housing **102** of access apparatus **100**.

Housing **1002** includes a first tubular portion **1018**, a second tubular portion **1020**, and a third tubular portion **1022**. First tubular portion **1018** is oriented substantially parallel to longitudinal axis B-B. Second and third tubular portions **1020**, **1022** converge into first tubular portion **1018** and each is define an axis that is at an oblique angle relative to longitudinal axis B-B.

First tubular portion **1018** includes a first port **1006** adapted to receive a surgical instrument and at least a portion of a first seal assembly **1012**. Second tubular portion **1020** includes a second port **1008** adapted to receive a surgical instrument and at least a portion of a second seal assembly **1014**. Third tubular portion **1022** includes a third port **1010** adapted to receive a surgical instrument and at least a portion of a third seal assembly **1016**. First, second, and third seal assemblies **1012**, **1014**, **1016** form a fluid-tight seal around a surgical instrument when said surgical instrument is inserted through first, second, and third ports **1006**, **1008**, **1010**, respectively.

Housing **1002** further includes an insufflation assembly **1024** configured to be connected to a source of insufflation gases or a vacuum system (not shown). Insufflation assembly **1024** includes an insufflation port **1028** and a stop-cock valve **1026**. Insufflation port **1028** defines a lumen **1030** (see FIG. **30**) disposed in fluid communication with an inner portion of housing **1002** and includes an external thread **1032** for facilitating connection to a source of insufflation gases or a vacuum system.

Stopcock valve **1026** has an open position and closed position and is therefore capable of controlling fluid flow through insufflation assembly **1024**. In the open position, stopcock valve **1026** allows fluid flow through insufflation assembly **1024**. In the closed position, stopcock valve **1026** prevents or hinders fluid flow through insufflation assembly **1024**. In one embodiment, stopcock valve **1026** includes a lever **1034** extending therefrom. Lever **1034** facilitates rotation of stopcock valve **1026** with respect to housing **202** between the open and closed positions. In the depicted embodiment, insufflation assembly **1024** is positioned on first tubular member **1018**. In use, a user actuates stopcock valve **1026** between the open and closed positions by rotating stopcock valve **1026** relative housing **1002** through lever **1034**.

With reference to FIGS. **24-31**, first tubular member **1018** has an opening **1036** configured to receive a portion of insufflation assembly **1024**. Opening **1036** is disposed in fluid communication with insufflation port **1028** and a bore **1210** defined through first tubular member **1018**. In operation, Opening **1036** permits fluid exchange between bore **1028** and a source of insufflation gases or vacuum system fluidly coupled to insufflation assembly **1024**.

As seen in FIGS. **24**, **26**, and **29**, first tubular portion **1018** further includes a plurality of ribs **1282** disposed around bore **1210**. Ribs **1282** facilitate the insertion of a surgical instrument through bore **1210**. Bore **1210** is configured to accommodate at least a portion of first seal assembly **1012**.

As seen in FIGS. **24** and **26**, first seal assembly **1012** is fixed to first tubular member **1018**. First seal assembly **1012** includes a cover **1080**, an instrument seal **1082**, a knob **1084**, a seal cover **1086**, and a duckbill valve **1088**. Cover **1080** defines an opening **1092** extending therethrough. Opening **1092** is dimensioned to receive a surgical instrument and

leads to an inner cavity **1094** (see FIG. **26**) of cover **1080**. Inner cavity **1094** is configured to receive instrument seal **1082**. Instrument seal **1082** defines an aperture **1096** extending therethrough. Aperture **1096** is dimensioned to receive a surgical instrument. In use, instrument seal **1082** forms a fluid-tight seal around a surgical instrument inserted through aperture **1096**.

First seal assembly **1012** can be connected to port **1006** by snapping knob **184**s onto port **1006**. It is envisioned, however, that first seal assembly **1012** may be connected to port **1006** by any suitable means. When first seal assembly **1012** is assembled, instrument seal **1082** is located between cover **1080** and knob **1084**. As seen in FIG. **26**, instrument seal **1082** includes a ring **1098** protruding distally therefrom. Ring **1098** presses instrument seal against a proximal wall **1200** of knob **1084**. Knob **1084** includes a ring **1202** protruding proximally therefrom. Ring **1202** is adapted to be received inside an annular space **1204** formed in cover **1080**. During assembly, ring **1202** is positioned inside annular space **1204** to facilitate interconnection between cover **1080** and knob **1084**.

Knob **1084** includes a longitudinal opening **1206** configured to receive a surgical instrument and at least a portion of seal cover **1086**. Seal cover **1086** includes a hole **1208** adapted to receive a surgical instrument. During operation, seal cover **1086** helps secure duckbill valve **1088** to first seal assembly **1012** and first tubular member **1018**. Duckbill valve **1088** is partially disposed in bore **1210** of first tubular portion **1018**. In operation, duckbill valve **1088** forms a fluid-tight seal around a surgical instrument inserted therethrough and closes in the absence of a surgical instrument extending therethrough.

As seen in FIG. **24**, second tubular portion **1120** of housing **1002** has inner surfaces **1140** forming a bore **1138**. Bore **1138** extends through second tubular portion **1120** and is configured to receive a portion of tubular member **1004** and a portion of second seal assembly **1014**. Second tubular portion **1120** further includes an inner thread **1144** formed about a proximal end **1142** of inner surface **1140**. Inner thread **1144** is configured to threadedly engage a portion of second seal assembly **1014**.

Second seal assembly **1014** is substantially identical in construction and operation as second seal assembly **1014** of access apparatus **100** and thus will not be described in further detail herein. Like ports of second seal assembly **1014** will be identified with like reference characters as second seal assembly **114**.

As seen in FIGS. **24** and **26**, third tubular portion **1122** of housing **1002** defines a bore **1214** dimensioned to receive a surgical instrument. Bore **1214** is disposed in fluid communication with third port **1110**. Third seal assembly **1016** covers third port **1110** and includes cap **1216**, an instrument seal **218**, and a duckbill valve **1220**. Cap **1216** has a hole **1222** extending therethrough. Hole **1222** is dimensioned to receive a surgical instrument and leads to bore **1214** of third tubular portion **1122**. Instrument seal **1218** is secured between cap **1216** and duckbill valve **1222** and defines an opening **1224**. Opening **1224** is configured to receive a surgical instrument. In use, instrument seal **1218** forms a fluid-tight seal around a surgical instrument inserted through opening **1224**. Duckbill valve **1220** is adapted to form a fluid-tight seal around a surgical instrument inserted therethrough and close in the absence of a surgical instrument.

As seen in FIGS. **24-26**, tubular member **1004** has a proximal portion **1230** and a distal portion **1232**. Proximal portion **1230** is positioned inside second tubular portion **1120** of housing **1002**. In addition, tubular member **1004** includes a dividing wall **1246** extending therethrough. In one embodiment, dividing wall **1246** has a substantially S-shaped transverse cross-sectional profile. It is contemplated that dividing wall **1246** may have a sinusoidal, zig-zag, C-shaped, triangular, straight, diagonal or any other suitable transverse cross-sectional profile. In an embodiment, dividing wall **1246** is made of a flexible and/or resilient material. Dividing wall **1246** divides the inner cavity of tubular member **1004** into first and second passageways **1276**, **1278**, as depicted in FIG. **28**.

As seen in FIGS. **24** and **26**, a sleeve **1248** is partially poisoned within proximal portion **1230** of tubular member **1004**. As seen in FIG. **26**, another portion of sleeve **1248** is disposed inside bore **1138** of first tubular portion **1120**. Sleeve **1248** facilitates interconnection between tubular member **1004** and housing **1002**.

As shown in FIGS. **24** and **26**, tubular member **1004** further includes a lateral aperture **1240** for establishing fluid communication between bore **1210** of first tubular portion **1210** and passageway **1276** of tubular member **1004**. In addition, tubular member **1004** includes another lateral aperture **1242** for establishing fluid communication between bore **1214** of third tubular portion **1122** and passageway **1275** of tubular member **1004**. Lateral aperture **1242** is disposed in diametrically opposed relation to lateral aperture **1240**.

As shown in FIGS. **24** and **26**, access apparatus **1000** also includes a pair of fittings **1290**, **1292** each adapted to partially cover a lateral aperture **1240**, **1242**. Fitting **1290** is positioned between housing **1002** and tubular member **1004** and helps secure tubular member **1004** to housing **1002**. Moreover, fitting **1290** defines a hole **1294** aligned with lateral aperture **1240**. Fitting **1292** is also disposed between housing **1002** and tubular member **1004** and aids in securing tubular member **1004** to housing **1002**. Further, fitting **1292** includes a hole **1296** aligned with lateral aperture **1242** of tubular member **1004**.

As discussed above, at least a portion of tubular member **1004** is made of a flexible and/or resilient material such as, for example an elastomer, stainless steel wire, shape-memory alloys, polycarbonate, etc. In the embodiment depicted in FIGS. **26** and **27**, tubular member **1004** includes one or more strands **1298** embedded in or connected to a portion thereof. Strands **1298** are made of a flexible and/or resilient material. As seen in FIG. **26**, strands **1298** surround a portion of tubular member **1004**. In one embodiment, strands **1295** are made of a resilient material that helps maintain tubular **1004** in a straight position or in a bent position after being manually bent by the user.

In operation, a user inserts access apparatus **1000** into a patient through a body lumen or via an incision. Then, the user advances access apparatus **1000** toward the target body cavity. Optionally, the user insufflates the target body cavity with insufflation gases. To insufflate the target body cavity, the user fluidly connects access apparatus **1000** to a source of insufflation gases via insufflation assembly **1024**. Before, after, or during insertion of access apparatus **1000**, the user may bend tubular member **1004** manually to reach the target body cavity. Next, the user activates the source of insufflation gases to expand the body cavity. The user may then introduce one or more surgical instruments through first, second, and/or third seal assemblies **1012**, **1014**, **1016**.

It will be understood that various modifications can be made to the embodiments disclosed herein. For example, tubular members **1004** of various sizes may be connected to housing **1004**. Therefore, the above description should not be construed as limiting, but merely as exemplifications of

embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the present disclosure.

What is claimed is:

1. A surgical access apparatus for providing access inside a body, comprising:

a housing having a first port;

a tubular member extending distally from the housing and defining a longitudinal axis therealong, wherein the tubular member includes a lumen extending therethrough;

a shaft insert disposed in the lumen of the tubular member, the shaft insert including a series of grooves formed in an outer surface thereof, wherein the shaft insert forms first, second, and third passageways between the grooves and an inner surface of the lumen of the tubular member, the first, second and third passageways extending along the lumen of the tubular member, wherein each of the first, second, and third passageways is adapted to receive a surgical instrument, the shaft insert including an atraumatic blunt tip at a distal end thereof and extending distally of the tubular member; and

a first seal assembly covering the first port of the housing and defining a first passage disposed in communication with the first passageway defined by the shaft insert in the tubular member, wherein the first seal assembly is adapted to form a seal around the surgical instrument inserted through the first passage of the first seal assembly.

2. The access apparatus according to claim **1**, wherein the tubular member is made of a one of rigid material and a flexible material.

3. The access apparatus according to claim **1**, wherein the housing includes a first tubular portion defining an axis that is at an oblique angle relative to the longitudinal axis of the tubular member.

4. The access apparatus according to claim **3**, wherein the first tubular portion of the housing includes a bore disposed in fluid communication with the first port.

5. The access apparatus according to claim **1**, wherein the housing includes a second port and a third port, each of the second and third ports being adapted to receive a surgical instrument.

6. The access apparatus according to claim **5**, wherein the housing includes a second tubular portion having a bore, the bore being disposed in communication with the second port and the second passageway.

7. The access apparatus according to claim **6**, wherein the second tubular portion of the housing defines an axis that is oriented substantially parallel to the longitudinal axis of the tubular member.

8. The access apparatus according to claim **6**, further comprising a second seal assembly releasably connected to the second tubular portion of the housing, the second seal assembly having passage disposed in communication with the second passageway, wherein the seal assembly is adapted to form a seal around a surgical instrument inserted through the second passage.

9. The access apparatus according to claim **6**, wherein the second passageway is configured to receive an obturator in the absence of the second seal assembly.

10. The access apparatus according to claim **7**, wherein the housing includes a third tubular portion having a bore, the bore being disposed in communication with the third port and the third passageway.

11. The access apparatus according to claim **10**, wherein the third tubular portion of the housing defines an axis that is at an oblique angle relative to the longitudinal axis of the tubular member.

12. The access apparatus according to claim **10**, wherein the third passageway is configured to receive an endoscope.

13. A surgical access apparatus for providing access inside a body, comprising:

a housing having a first port;

a tubular member extending distally from the housing and defining a longitudinal axis therealong, wherein the tubular member includes a lumen extending therethrough;

a dividing wall positioned along the lumen of the tubular member, the dividing wall having a substantially S-shaped transverse cross-sectional profile, wherein the dividing wall divides the lumen into first and second passageways, wherein each of the first and second passageways is adapted to receive a surgical instrument; and

a first seal assembly covering the first port of the housing and defining a first passage disposed in communication with the first passageway defined by the dividing wall, wherein the first seal assembly is adapted to form a seal around the surgical instrument inserted through the first passage of the first seal assembly.

14. The access apparatus according to claim **13**, wherein the tubular member is made of a one of rigid material and a flexible material.

15. The access apparatus according to claim **13**, wherein the housing includes a first tubular portion defining an axis that is at an oblique angle relative to the longitudinal axis of the tubular member.

16. The access apparatus according to claim **15**, wherein the first tubular portion of the housing includes a bore disposed in fluid communication with the first port.

17. The access apparatus according to claim **13**, wherein the housing includes a second port and a third port, each of the second and third ports being adapted to receive a surgical instrument.

18. The access apparatus according to claim **17**, wherein the housing includes a second tubular portion having a bore, the bore being disposed in communication with the second port and the second passageway.

19. The access apparatus according to claim **18**, wherein the second tubular portion of the housing defines an axis that is oriented substantially parallel to the longitudinal axis of the tubular member.

20. The access apparatus according to claim **13**, wherein the dividing wall is made of at least one of a flexible and resilient material.

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